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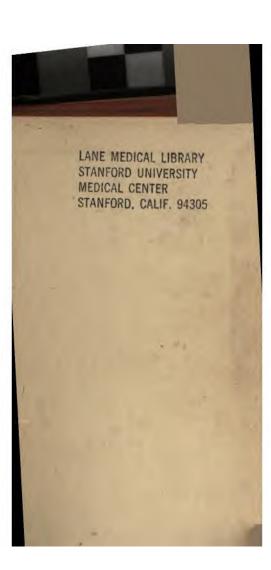
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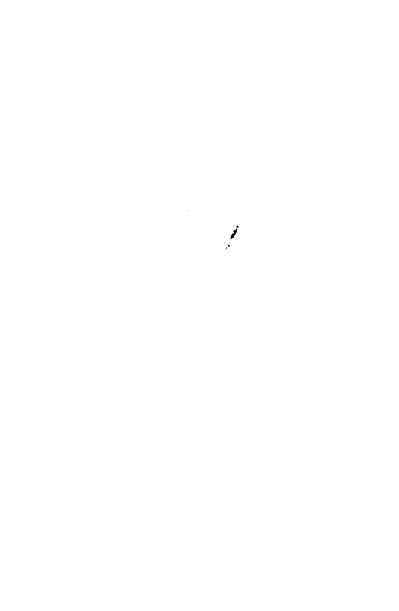
IN HONOR OF
ANDREW WILLIAM HOISHOLT, M.D.

CLINICAL PROFESSOR OF PSYCHIATRY 1912-1920

STANFORD UNIVERSITY SCHOOL OF MEDICINE

11sh.





## **OPHTHALMIC**

AND

## OTIC MEMORANDA.

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REVISED EDITION.

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## PREFACE.

THE little book that is herewith presented to students and practitioners of medicine has been prepared with great care. It aims to give a concise and correct outline of our present knowledge of Ophthalmology and Otology, and to serve as a kind of Dictionary of these subjects. We shall be sorry if it is ever used to acquire a primary knowledge of either of these sciences, or if it is trusted for complete directions as to the diagnosis and treatment of ophthalmic and aural diseases. The anatomical portions, however, will be found quite as complete as in any one book in our language; as we have made a systematic grouping of what has hitherto been found only by consulting several works in English, German, and French. We believe our book will prove especially useful to those who are attending lectures upon the subjects of which it treats, but who are too busy during the lecture-season to consult the larger treatises. We hope, also, that even experienced general practi-

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tioners and specialists will find it a trustworthy aid to the memory, in recalling facts which sometimes escape the minds of the most learned.

In endeavoring to make the book as small as possible, we have made the text very concise, but we trust there has been no sacrifice of clearness on that account. The treatment recommended for the different diseases is that which has been found generally efficacious, or which has been suggested by a not inconsiderable personal experience in public and private practice. Points regarded as still unsettled are indicated by interrogation-marks. The derivations of nearly all technical terms have been given with the words themselves, as they occur in the text; and for greater convenience an alphabetical list of them has also been placed at the end of the book. Where the derivation is doubtful, it is followed by an interrogation point. Where the name of a contributor to the science occurs in the text, it is usually followed by his country and century in brackets.

The following abbreviations have been used:— Gr. for Greek; Lat. for Latin; Lat. equiv. for Latin equivalent; Ant. for anterior; Post. for posterior; O. for origin; I. for insertion.

The Bibliography gives the titles of the works consulted in the preparation of the Memoranda.

#### PREFACE TO REVISED EDITION.

THIS little work has met with so much favor, and so many editions have been called for, that the authors have attempted to thoroughly revise it, and thus to make it more worthy of the commendation of the profession. When first written, the desire for condensation led to a greatly abbreviated style, and to some omissions. These defects have been remedied as far as has been practicable, and the whole has been carefully revised. Many parts have been re-written, and thirty pages of new matter have been added. Some of the new material has been inserted by enlarging previous chapters, and some in the form of an Appendix. We believe that the book will now be found abreast of the times.

The authors would take this opportunity of repeating that the work is rather a dictionary of Ophthalmic and Otic science than a text-book; that it gives only a bare outline of the subject of which it treats; and that it is never to be recommended as a substitute for the larger works.

New York, March 22, 1880.



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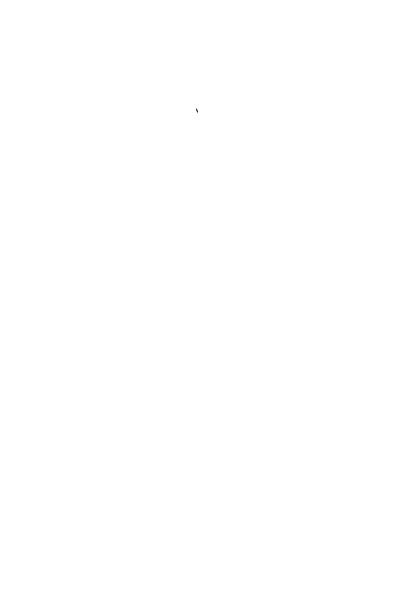
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## PART I.

OPHTHALMIC MEMORANDA.

#### CHAPTER I.

THE ANATOMY AND PHYSIOLOGY OF THE EYE.

THE visual apparatus consists of the eyeballs and their accessory parts for collecting luminous impressions, and the optic nerves for conveying them to the brain. Each eyeball forms a hollow, spherical box, blackened on its interior surface, having a system of convex lenses in front for forming images of external objects, and a special nervous membrane—the retina—behind, for receiving them. The whole is like a camera obscura. The light, passing through the cornea, aqueous humor, lens, and vitreous humor, is focussed upon the retina (which appreciates both intensity and color), and inverted images of objects are formed there. These impressions are conveyed to the brain by the optic nerves, and thence results the sensation which we call vision. The manner in which we gain our visual perception of an object, single and erect, from its two inverted retinal images, cannot be satisfactorily explained. The amount of light admitted to the eye is regulated by the reflex movements of the iris—the pupil contracting in a bright light and dilating in a feeble one. The eye possesses the faculty of accommodation,—that is, of adjusting itself for vision at different distances, so that the focus of the rays of light is kept in the retina alike when we look at a far-off landscape or read a book. Only a small part of an object can be seen distinctly at any one time, the surrounding parts being more or less blurred; on the other hand, the eye is so rotated by its muscles as to command a very extensive The two eyes act in perfect harmony. and the images being symmetrically disposed on the two retinæ are combined into a single impression. The two retinal images are slightly different (each eye seeing its corresponding half of the object most distinctly). and from their union result our ideas of solidity. Our ideas of distance are derived from the muscular efforts required to see distinctly and from experience.

#### ORBITS.

Bony cavities in which the eyeballs are securely contained. Shaped like four-sided pyramids, bases pointing forward and outward, apices backward and inward. About 13 inches deep. Axes inclined to each other at angle 42°-43°. Each orbit formed from

seven bones: frontal, sphenoid, ethinoid, superior maxillary, palate, malar and lachrymal, three former being common to both orbits. ROOF formed by frontal and sphenoid; very thin; separates orbit from cranial cavity and frontal sinus; fossa for lachrymal gland at outer, anterior angle; depression (fovea trochlearis) for pulley of superior oblique muscle at inner angle. FLOOR, by superior maxillary, malar and palate bones; near centre, infra-orbital groove running from behind forward, converted into canal which opens on face 1 inch below orbital margin, transmits infra-orbital vessels and nerve. INNER WALL, by superior maxillary, ethmoid, sphenoid and lachrymal bones; very thin, 123-64 in.; anteriorly has lachrymal groove (for lachrymal sac) bounded in front and behind by anterior and posterior lachrymal crests. OUTER WALL, by malar and sphenoid; thickest (18-13 in.); presents zygomatico-temporal and zygomatico-facial (or malar) foramina for nerves of same name. In suture between inner wall and roof are ant, and post, ethmoidal foramina for ethmoidal vessels and nasal nerve. Between roof and outer wall posteriorly is sphenoidal fissure for 3d, 4th, ophthalmic division of 5th, 6th nerves, and ophthalmic vein. Between floor and outer wall posteriorly is spheno-maxillary fissure for infra-orbital vessels and nerve and ascending branches from sphe-

no-palatine ganglion. BASE, facial opening of orbit 13 in. wide, 14 in. high ; has strong bony edge, pierced above, about 1 in. from median line of skull, by supra-orbital notch (or foramen) for supra-orbital vessels and nerve; bases 1 in, apart. APEX, formed by optic foramen and canal; canal funnel-shaped, runs between two roots of lesser wing sphenoid, backward, upward and inward to middle fossa of skull; in. long, 1 in, calibre; transmits optic nerve and ophthalmic artery. Orbits lined by periosteum (or periorbita) continuous at fissures and sutures with that of facial bones and with dura-mater; forms tendinous ring about optic foramen, giving origin to ocular muscles. On periosteum is layer of connective tissue and fat, forming cushion for eyeball; connective tissue thickened to form sheaths for muscles, vessels and nerves, and fasciæ for connecting different parts within orbit with each other and with periosteum. Such fasciæ connect cartilages of lids with edge of orbit and with capsule of globe and surround muscles of eye with funnel-like sheath. One. starting from optic foramen, surrounds optic nerve, then spreads over eyeball, tunica vaginalis bulbi, and is lost anteriorly on sclerotic; is pierced by tendons of muscles, with which it is connected; posterior part loosely attached, allowing eyeball to rotate in it, called Bonnet's capsule; part anterior to passage of tendons called *Tenon's capsule*. Rudimentary organic muscles found in orbit—external, internal and inferior orbital: supposed to strengthen union of lids with orbit; inferior, largest,  $\frac{1}{2}$ s inch thick, covers inf. orbital fissure.

#### OPTIC NERVES.

Origin in thalami optici and corpora quadrigemina, receiving filaments from corpora geniculata, tuber cinereum, lamina cinerea. ant. perforated space, gray substance of brain, and post. columns spinal cord. Fibres run forward, as optic tracts, beneath thalami and across crura to front of infundibulum, where they unite to form optic chiasm [Gr. xiaoua, the figure x in which they decussate. rests on olivary process, sphenoid bone. From inner end of each tract fibres cross to nerve of other side, and supply inner half opposite retina. Greater part run directly, without crossing, to outer half retina of same side. On ant. edge of chiasm fibres run from one nerve to other-ant, commissura arcuata, or inter-retinal fibres. On post, edge fibres run from one tract to other—post. commissura arcuata, or inter-cerebral fibres.\* Vessels of tract and chiasm from pia-mater and brain. nerves proper start from lateral portions chiasm, run divergent to optic foramina, thence

<sup>\*</sup> This form of decussation denied by some authors.



ish prominence about  $\frac{1}{17}$  in. diameter. (p. 61). Nerve-fibres radiate from disc into retina in all directions. Central artery of retina, or arteria centralis retinæ [Lat. equiv.], enters nerve 3-4 in. behind eyeball and runs forward in centre of nerve to papilla where it branches into retina. Enclosed in sheath of its own. Nutrient capillaries of nerve from ant. cerebral, central artery, and vessels of neurilemma; anastomose in papilla with branches from short ciliary. Central vein accompanies artery, enclosed in separate sheath: leaves nerve a little nearer eveball; empties into cavernous sinus, anastomosing with ophthalmic and so with facial. Lymbhatics numerous in nerve and sheaths. Space between sheaths regarded as lymph-space, with which lymphatics of nerve and post, parts of eye connect. This space connects with arachnoidal lymph-space of brain.

#### EYEBALL, OR BULBUS OCULI.

In ant. part orbit to outer side of its axis, about equi-distant from upper and lower walls. Spheroidal form with segment of smaller sphere projecting from ant. surface. Anteroposterior diameter about .95 in. Transverse, .92 in. Vertical, .90 in. Weight, 6.3-8 grammes. Volume, about † cubic in. Anterior pole, geometric centre of cornea. Post. pole, geometric centre of back part of globe, or fundus (Lat. for bottom). Optic axis,

imaginary straight line from pole to pole. Visual line, imaginary straight line drawn through nodal point from macula lutea to object; it usually cuts the cornea a little above the optic axis, and at an angle of 3-7° to the inner side of it. Nodal point, centre of curvature of the refracting surfaces. It lies a little in front of the posterior surface of the lens. Equatorial plane, imaginary plane through centre, perpendicular to axis, dividing globe into ant. and post. hemispheres. Equator, line where eq. plane cuts surface. Meridianal planes, imaginary planes coinciding with axis. Meridians, lines where meridian planes cut surface.

Eyeball composed of 3 tunics: (a) sclerotic and cornea, (b) uveal tract, or tunica vasculosa, comprising choroid, ciliary body and iris, (c) retina; and 3 humors: (a) aqueous,

(b) crystalline, (c) vitreous.

#### SCLEROTIC, OR SCLERA.

[Gr. σκληρος, hard.]

Opaque, post. & outer tunic, of which ant. & is formed by cornea. Seen between lids anteriorly as "white of the eye." Forms firm capsule for globe, helping to maintain proper shape and protect parts within. Gives attachment to ocular muscles. Thickest posteriorly (45 in.) where it is joined by optic sheaths; at

ant. border, in thick. Foramen posteriorly to inner side of centre, for optic nerve-entrance (p.61); in diameter. Terminates anteriorly in cornea, elements being transformed into corneal tissue; union by bevelled surfaces, sclera overlapping cornea anteriorly, and to slighter extent posteriorly; slight circular depression, or sulcus, around corneal margin. Outer surface somewhat rough, connected by loose connective tissue to sheath of globe, and anteriorly to conjunctiva by shorter filaments-subconjunctival tissue. Inner surface closely connected to choroid and ciliary body by layer of connective tissue, lamina fusca, containing pigment-cells. Sclera composed chiefly of connective tissue with elastic fibres, pigment-cells, and cells corresponding to corneal corpuscles, intermixed. Connective-tissue bundles have longitudinal and circular course interlacing to form dense mesh-work: form circular ring at ant. edge around cornea. Pigment-cells most abundant at inner surface. At ant. edge near inner surface is circular space surrounding cornea, Schlemm's canal, lined by endothelium and enclosing venous plexus: receives veins from sclera and from ciliary plexus; communicates with ant, chamber and ant, ciliary veins; regarded by some as venous reservoir for ciliary muscle. Sclera pierced around optic nerve entrance by long and short ciliary arteries, post, ciliary veins and short ciliary nerves; in

region of equator by venæ vorticosæ; around corneal border by ant. ciliary arteries and veins; passages of long and ant, ciliary arteries and vorticose veins very oblique. Sclerotic receives blood from ciliary system; vessels not numerous, and form coarse net-work; contains around optic nerve-entrance the post. vascular zone (zone of Zinn or Haller), formed from twigs of short ciliary, which sends branches to optic nerve anastomosing with those of central artery; thus forming the only connection between ciliary and retinal systems. On ant. surface, around cornea, is ant. vascular zone formed from episcleral or subconjunctival branches of ant. ciliary vessels; about in. wide; anastomoses with conjunctival vessels. Existence of nerves in sclera doubtful.

#### CORNEA.

#### [Lat. cornu, a horn.]

Transparent, highly-polished membrane, forming anterior  $\frac{1}{6}$  of external tunic and projecting from sclerotic like segment of smaller sphere. Ellipsoidal shape with radius of curvature a little less than 8 mm. Slightly more convex in vertical than in horizontal meridian. Transverse diameter longer than vertical, owing to overlapping of sclerotic above and below. Thickness at centre,  $\frac{1}{28}$  in.; at periphery,  $\frac{1}{22}$  in. Refractive index, 1.342. Distinguish five layers from without inwards:

(1.) Conjunctival epithelium.

(2.) Ant. elastic lamina, Bowman's or Reichert's membrane.

(3.) Substantia propria, or true corneal

tissue.

(4.) Post. elastic lamina, or Descemet's membrane.

(5.) Post. epithelium.

Layer of conjunctival epithelium, 2500 in. thick; consists of 2-3 layers transparent nucleated cells, superficial ones flattened, deeper ones oblong and placed perpendicularly to surface: passes over at edge (limbus) of cornea into epithelium of ocular conjunctiva. Bowman's membrane 2009-2000 in. thick, firm, elastic, homogeneous basement-membrane, quite resistant to chemical agents. True corneal tissue about in thick; consists of fine, highly-refractive, connective tissue fibrillæ united into bundles and these again into lamellæ, whose general direction is parallel to surface; space between fibrils, bundles and lamellæ is filled by semi-fluid, cement-like substance; in this is system of anastomosing spaces and canals containing serous fluid, network of corneal corpuscles. and wandering cells (?). Corneal corpuscles are flat or fusiform nucleated cells, with granular protoplasm, sending out anastomosing processes in all directions. Wandering-cells are lymphoid corpuscles endowed with amceboid movement. Descemet's mem

frame who in thick at margin; soon centre; elastic, structureless inner bas membrane, said by some to have la formation; continuous at margin with meetum pectinatum of iris. Posterior places, forms endothelium of Desce anembrane; layer of flattened, polygona cleated cells. Blood-vessels: none, exce periphery, where there is a zone 15-1 wide, of capillary loops formed from episo branches of ant. ciliary arteries; anastor with conjunctival branches; veinlets er into ant, ciliary. Nerves: 20-45 twigs ch from ciliary, few from conjunctival; for enter through sclera; latter pass in f pumbus. Just after entering cornea lose Palla; form very intricate network bene psowman's membrane and in ant. epithe gaver, and smaller plexus near Descemspeembrane; fibres run forward and end amo seperficial epithelial cells in manner not settled.

## UVEAL TRACT (p. 8).

[Lat. and, grapes.]

CHOROID [Gr. Xopton, chorion, and etdo runs from edge of optic nerve-er grance to imaginary boundary, ora serrate little in front of equator. Lies between Electronic and retina, to which it is most closel Treached around nerve and at ora. Thick ness, 300-100 in. Following layers from sclerotic inward:—

(1.) Lamina fusca [Lat. fuscus, dark], or

supra-choroidea.

(2.) Tunica vasculosa.

(3.) Membrana chorio-capillaris, or Ruyschiana.

(4.) Lamina elastica, vitreous or limiting

membrane.

Inner pigment-layer, often described with choroid, belongs to retina. Lamina fusca composed of connective tissue containing free nuclei, and nucleated, branching pigment-cells, brown and black; surrounds vessels and nerves passing forward to iris and ciliary body: leaves space-supra or peri-choroidal space-between choroid and sclera, lined by endothelium, communicating with Tenon's space through canals around venæ vorticosæ: considered as lymph-space. Tunica vasculosa consists of the larger arteries and veins, which run tortuous course and pass gradually into deeper capillary layer. Membrana choric-capillaris, fine capillary network covering inner surface from optic nerve to ora serrata; meshes finest posteriorly. Limiting membrane, about support in, thick; structureless, hyaline membrane covering, inner surface of capillary layer. Elements of choroid are bound together by stroma-a network of fibres in whose meshes are variously-formed pigment-cells and lymph

old corpuscles. Smooth unstriped muscular ally have been found along vessels, and scattered through stroma. Pigment less abundant in light eyes. Arteries: short posterior ciliary which become wholly lost in capillary layer not passing beyond ora serrata: recurrent branches from long posterior and anterior ciliary. Veins: after very numerous ramifications and anastomoses unite into larger venes verticoses, 4-6 in number, which pass out through sclera near equator; carry off most of blood from uveal tract, only a small part escaping by ant. ciliary veins. Nerves from 3d, 5th and sympathetic, through long and short ciliary, which pierce sclerotic around optic nerve-entrance; form fine network in which many ganglionic cells are found.

CILIARY BODY is portion of uveal tract between ora serrata and iris, being direct continuation of choroid; consists of ciliary muscle, covered by choroidal stroma, and ciliary processes. Ciliary muscle or tensor choroidea; layer of unstriped muscular fibres, situated in anterior and outer part of ciliary body, separated from sclerotic by lamina fusca: in vertical section has prismatic shape, base forward, 32-36 in. long, 32 in. thick at base; external fibres have meridional course forming thickest part of muscle; middle fibres diverge and radiate toward inner side, where they form a circular plexus; at ant. internal

angle are separate, circular bundles, the annular muscle of Müller; meridional and radiate fibres arise by tendinous ring from inner side of Schlemm's canal from which some pass forward into cornea; are connected with ciliary processes and choroid. Supplied by 3d nerve. Ciliary muscle is probably the exclusive agent in accommodation, but exact mode of its action is not settled: favorite theory is that of Helmholtz,-that meridional fibres draw choroidal border forward and circular fibres draw parts inward, thus relaxing zonula and allowing lens to become more convex from its own elasticity. During accommodation, the pupil contracts, the periphery of the iris moves backward, the lens is pushed forward, its anterior and posterior surfaces becoming more convex. The ciliary muscle was discovered by Brücke in 1846: first complete description by Müller in 1857. p. 245.

CILIARY PROCESSES; 70-80 parallel, meridional folds of choroid, rising gradually from behind forward, and forming plaited zone—looking like a ruffle—on inner surface of ciliary muscle: about 10 in. long; possess same structure as choroid, without its capillary layer; covered internally by continuation of retinal pigment: joined by external (anterior) margins to ciliary muscle, internal (posterior) margins and bases being free and resting in corresponding depressions on surface of zonula; space about 20 in. wide left be



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16 IRIS.

tween bases of processes and border of lens.

Arteries of ciliary body:—Long post, ciliary run forward, one on outer and one on inner side of globe, penetrate ciliary muscle and, with branches from anterior ciliary, form circulus arteriosus major at its anterior border; smaller circle formed in same way farther back; capillary plexus of muscle derived from circles and also directly from ciliary arteries. Arteries of ciliary processes derived from circulus major. Veins of muscle and processes empty chiefly into venæ vorticosæ,

some joining with ant. ciliary.

IRIS [Gr. iris, a rainbow]. Uveal tunic bends sharply in toward optic axis, 26 in. from corneal margin, to form iris-a circular diaphragm with central opening called pupil. Pupil situated a little to nasal side of centre ; mean diameter \$5-25 in.; fringed with pigment from bevelling off of anterior rim; varies in size from muscular action; when dilated to maximum, edge floats free in aqueous humor; when contracted, rests on anterior capsule of lens. Iris 20-24 in. wide; Transfer in. thick. Attached at ciliary margin by its suspensory ligament, ligamentum pectinatum iridis, formed by radiating fibres which run from margin of anterior surface and bend forward at edge to join fibrous network around border of Descemet's membrane. Anterior surface un-

even, divided by jagged line into two ones: (1) pupillary, 15 in. wide, and marked by fine radiating folds; (2) ciliary, 3 in. wide (allowing 25 in. for pupil), and marked by 5 to 7 concentric folds; covered by layer of irregular cells continuous with those of Descemet's membrane. Post, surface covered by layer of pigment-cells, tapetum or uvea [Lat. tapete, carpet], continuous with pigment layer of ciliary processes; marked by 70-80 shallow, radiating folds. Stroma is loose, connective-tissue network, continuous with that of choroid and ciliary body, containing muscular fibres, vessels, nerves, round and stellate cells. In dark eyes, cells are strongly pigmented and often seen as superficial, irregular spots. In light eyes, cells are nonpigmented and color is an interference thenomenon. Layer of circular muscular fibres about 300 in. thick and 1/2 in. wide around border of pupil forming sphincter pupillæ. Radiating fibres, dilatator pupillæ, run from ciliary border toward pupil; form network within sphincter and unite with it. Muscular fibres lie near post, surface, being separated from uvea by thin limiting membrane. Arteries from circulus major iridis in ciliary muscle; walls very thick; run toward pupil, giving out branching network, and near pupillary margin form circulus arteriosus iridis minor; end in loops and pass into veins at edge of pupil. In albinos, color of blood shows through walls of vessels. Veins mostly pass back to plexus of ciliary processes and so into venæ vorticosæ; some through veins of ciliary muscle into ant. ciliary. Nerves from 3d, 5th, and sympathetic through long and short ciliary; form fine plexus in stroma; sphincter supplied by 3d, dilatator by sympathetic; sensitive fibres from 5th. Movements of iris reflex from action of light on retina, and accommodative in unison with ciliary muscle; movements of the two irides consentaneous. Intersection of iris, ciliary body, cornea, and sclera, is called the iritic angle.

# RETINA.

# [Lat. rete, a net.]

Inner tunic of eye lying between choroid and vitreous body from optic nerve to ora serrata. Delicate grayish color, quite transparent: about  $\frac{1}{76}$  in, thick at papilla, growing thinner toward ora serrata, where it is about  $\frac{1}{200}$  in, thick. Composed of nervous elements and modified connective tissue like neuroglia of brain. Layers from vitreous outward:—

- (1) Membrana limitans interna.
- (2) Optic nerve fibres.
- (3) Ganglion cells.
  (4) Internal molecular.
- (5) Internal granules.
- (6) External molecular or intergranular.
- (7) External granules.
  (8) Limitans externa.

(9) Rods and cones or Jacob's membrane.

(10) Pigment layer.

(1) Hyaline memb. made up from retinal

connective tissue : 12600 in. thick.

(2) Transparent, homogeneous fibres, like those of brain, radiating from optic papilla in all directions, devoid of medullary sheaths; not sensitive to light; layer 12 in. thick posteriorly, decreasing toward ora.

(3) Ganglion-cells with nuclei and nucleoli, having branching processes in variable number, some of which appear identical with nerve-fibres: layer about \$\frac{3}{6}\text{ug}\$ in thick.

(4) Finest nerve-fibres and connective-tissue network; fine granules of unknown na-

ture : layer about 1300 in. thick.

(5) Small round cells with large nuclei connected with radial connective-tissue fibres and nerve-fibres; processes from cells pass through molecular layer and unite with ganglion-cells (?); layer about Taou in thick.

(6) Connective tissue, nuclei, granular substance, nerve-fibrillæ: layer about 2000 in.

thick.

(\*) Ellipsoidal-shape, transversely striated, with long axis perpendicular to plane of retina; form nucleated enlargements of internal rod and cone fibres which run through this layer to reach (6) in which they arise (?). Inner part of layer devoid of granules—ext. fibre layer of Henle. Layer Tobo - 500 in. thick.

(8) Membranous expansion of radial con-

nective-tissue fibres; not continuous, but per-

forated by numerous foramina.

(o) Is perceptive layer. Rods and cones packed together like palisades forming external nervous layer; probably termini of optic-nerve fibres; have striated appearance from fine lines of connective tissue surrounding them; divided into external and internal segments connected together by sheath and filled with highly refractive molecular matter; delicate fibres, rod and cone fibres, run inward from rods and cones and appear to arise by club-shaped and finely-fibrillated expansions in ext. molecular layer: ext. granules are connected with them. Existence of axial fibres in rods and cones doubtful. Rods are cylindrical, shu in. long, ston in, thick. Cones flask-shaped, about sto in. long, stood thick. Layer about 100 in. thick.

(10) Hexagonal cells pressed closely together containing brownish-black pigment and held together by homogeneous connective tissue; send processes inward which surround rods and cones—pigment-sheaths: closely connected externally to choroid. Pigment almost absent in albinos, small amount in blondes, most in negroes. (See p 245.)

Supporting connective tissue consists of radial fibres stretched between limitans externa and interna, and spongy tissue, forming networks and sheaths for nervous elements.

Vellow spot of Soemmering [1804], or mac-

ula lutea [Lat. equiv.]—: most sensitive part and centre of direct vision. Situated about \( \frac{1}{1\structure} - \frac{1}{1\structure} \] in. to outer side of centre of optic disc. Horizontally oval and of variable size, \( \frac{1}{2}\lappa - \frac{1}{1\structure} \] in. diameter. Has central fossa-like excavation, fovea centralis, \( \frac{1}{2}\lappa - \frac{1}{2}\lappa \] in. in diameter. Nerve-elements of retina crowded together in macula at expense of connective tissue: ganglion cells and ext. granule layer thicker; rods replaced by closely-packed cones which converge toward centre; rod and cone fibres run diagonally or parallel to retinal surface; nervenibre layer interrupted, fibres passing around macula in curves: pigment cells increased, longer than broad, and darker color.

Ora serrata [Lat. for serrated boundary]: anterior limit of retina situated just posterior to ciliary body; gradual disappearance of nervous elements here, leaving only connective tissue and pigment layers which are continued forwards over ciliary body as pars ciliaris re-

tina.

Blood-vessels of retina: from central vessels of optic nerve which divide in papilla or just behind it; run chiefly up and down, generally two arteries and two veins in each direction: divide in arborescent manner and terminate in capillary network: do not pass beyond ora serrata: main branches lie in nerve-fibre layer, capillaries passing as far as internal granules; only capillaries at macula and no vessels whatever in foves.



# 24 VITREOUS AND AQUEOUS HUMORS.

ing life by folds falling together. Canal begins  $\frac{1}{2}$  in. from ora serrata, runs to border of lens and extends  $\frac{1}{12}$  in. along post. capsule toward pole (?).

VITREOUS HUMOR, HYALOID BODY, OR CORPUS VITREUM.

[Gr. valos, glass, and elos, like. Lat. vitreum, glass.]

Fills interior of eyeball behind lens. Structureless, gelatinous substance containing nuclei and cells (chiefly in peripheral parts) and connective-tissue filaments. Cells round, oval, stellate (?), nucleated and finely granular; endowed with mobility (?). Vitreous appears to have a cortex, composed of concentric layers, and a nucleus which lies anterporty to centre (?). Canal of Cloquet, or hyaloid canal ( in diameter) runs through centre from papilla to lens; contains hyaloid artery in fætal life, of which rudiment sometimes persists. No limiting or hyaloid membrane; bounded posteriorly by limiting membrane of retina, anteriorly by zonula and post, capsule of lens (?). Ant. surface hollowed out, forming fossa hyaloidea or patellaris in which lens rests. Receives nutriment from retina and uveal tract. Has no vessels or nerves. Refractive index 1.336.

AQUEOUS HUMOR.

Clear, slightly viscid, serous fluid filling

anterior and posterior chambers; weight 3½-5 grs.; sp. grav. 1.0053; composed of water (96.687 parts), albumen (.1223 parts), salts and extractive matter. Refractive index.1.3366.

Anterior chamber is space between ant. surface iris and lens and post. surface cornea. Posterior chamber is space between ant. surface lens, zonula and ciliary body behind, and post. surface iris in front. When pupil is dilated and edge does not rest on lens, the two chambers communicate.

## MUSCLES OF THE EYEBALL.

Eve is moved by 6 muscles, 4 recti and 2 oblique. Centre of motion lies on optic axis 1.77 mm. (about 1 in.) behind its centre. Rotary power greater inward and downward than upward and outward. Muscles of both eyes act in harmony, and movements are either associated (visual lines being parallel) or accommodative (visual lines convergent and ciliary muscle and sphincter of pupil participating). When all the muscles are at rest the visual lines converge toward a point 8"-12" in front of eyes, angle between them being called the muscular mesoropter. Muscle plane is plane passed through centre of motion and line passing from middle of origin to middle of insertion of muscle, Axis of

turning is perpendicular to muscle plane at turning point. Base line, line connecting centres of motion. Median plane, plane passed through vertical axis of head and centre of base line. Visual plane, plane passed through base line and visual lines. Vertical meridian is drawn perpendicular to equator when eye is in primary position. Primary position is that in which visual lines are horizontal and parallel to median plane, head being erect; all other positions are called secondary.

The 4 recti arise from tendinous ring around optic foramen, run forward divergently, strike the sheath of the eveball just behind equator and pierce it just before their insertion into the anterior part of sclerotic; tendons are flat and lines of their insertions are convex anteriorly. Muscles are surrounded by sheaths from orbital connective tissue, which unite with Tenon's capsule; this connection keeps muscles against globe and prevents too great retraction of tendons

after division.

Superior rectus: O. upper edge optic foramen. I. sclerotic about 1 in. from edge of cornea, inner end nearer cornea, than outer. Moves eye upward and inward, and inclines vertical meridian inward.

Inferior rectus: O. lower edge optic foramen. I. sclerotic about ? in. from cornea, a little to nasal side of centre. Moves eve downward and inward; vert. meridian outward.

External rectus: O. external edge optic foramen. I. sclerotic about \( \frac{1}{3} \) in. from cornea. Moves eye outward, not inclining vert. meridian.

Internal rectus: O. internal edge optic foramen. I. sclerotic about \( \frac{1}{2} \) in. from cornea. Moves eye inward, not inclining vert, meridian. Is strongest muscle.

Superior oblique: O. \$\frac{1}{26} - \frac{2}{2}\$ in. anterior to inner edge optic foramen: passes forward to upper and inner angle of orbit, over pulley, thence outward and backward, beneath sup. rectus, to upper, outer, and posterior quadrant of eyeball, where it pierces ocular capsule and has fan-shaped insertion into sclerotic, about \$\frac{3}{2}\$ in. from cornea. Moves eye downward and outward, inclining vert. meridian inward. Pulley (trachlea) of sup. oblique, is tendino-cartilaginous ring attached to depression at anterior, inner angle orbital plate of frontal bone.

Inferior oblique: O. anterior, inner angle orbital part of sup. maxillary bone, just external to lachrymal sac: passes outward, downward and backward beneath inf. rectus, then upward and backward between ext. rectus and globe, and piercing ocular sheath inserts into sclerotic close to sup. oblique, about \$\frac{3}{4}\$ in. from cornea. Moves eye

#### BLOOD-VESSELS OF EYE.

upward and outward, inclining vertical meridian outward.

| MOVEMENT.            | MUSCLE.                                       |
|----------------------|---|
|                      | Sup rectus and inf. oblique,                  |
|                      | Inf. rectus and sup. oblique.                 |
| Inward               |   |
| Upward and inward    | Sup. and int. recti and inf. oblique.         |
| Upward and outward   | Sup. and ext. recti and inf. oblique.         |
| Downward and inward  | Inf. and int. recti and sup. oblique.         |
| Downward and outward | Inf. and ext. recti and sup.oblique. (Wells.) |

The 3d (oculo-motorius) nerve supplies the superior, inferior and internal recti and inferior oblique.

The 4th (trochlear) nerve supplies superior

oblique.

The 6th (abducens) nerve supplies exter-

nal rectus.

The arteries of the muscles come from the ophthalmic.

The veins empty into ophthalmic and facial.

## BLOOD-VESSELS OF THE EVE.

ARTERIES: chiefly from ophthalmic, which arises from internal carotid at anterior clinoid process; about 1/2 in. calibre; enters orbit below and external to optic nerve, then crosses above nerve, between it and suprectus muscle, to inner wall and runs forward to inner angle: gives off lachrymal, supra-orbital, anterior and posterior ethmoidal,

anterior ciliary, long and short posterior ciliary, muscular, palpebral, centralis relinæ, (terminal branches) frontal and nasal. Infra-orbital (from int. maxillary of ext. carotid) sends branches to inf. rectus and inf. oblique muscles, and to lachrymal gland. Anterior cerebral sends nutrient capillaries to optic nerve. In eveball itself are two systems: (1) the retinal, derived from the centralis retinæ vessels, which supplies retina and optic nerve; and (2) the choroidal or ciliary, from ciliary vessels, which supplies uveal tract, sclerotic, margin of cornea and part of ocular conjunctiva. The short ciliary, arising from ophthalmic or one of its branches, are 4 to 6 small twigs which divide into about 20 and perforate sclerotic around optic nerve. The long ciliary having same origin as short, are two branches which perforate sclerotic a little further forward, one on medial and one on lateral side. The anterior ciliary, arising from muscular branches, pass through tendons of muscles and perforate sclerotic near corneal margin. The only connection between the two above systems is by small twigs around optic nerve entrance (p. 7).

Anastomosis: with deep temporal and transverse facial by malar branches, and middle meningeal by posterior branch from lachrymal. With anterior temporal and angular by supra-orbital. With infra-orbital



LYMPHATICS OF EYE.

30

and angular by nasal. With spheno-palatine

Veins: Smaller branches empty into 2 main trunks, superior and inferior ophthalmic, which run along roof and floor of orbit to cavernous sinus; have free anastomosis with facial in front; blood can thus escape from orbit in either direction. The short post ciliary veins are very small and receive blood only from sclerotic. There are no veins corresponding to long ciliary arteries.

## LYMPHATICS.

Lymph formed in eyeball anterior to ciliary body passes out through anterior chamber and canal of Schlemm. There are lymph-spaces in the meshes of the trabecular tissue forming the iritic angle (p. 18) called the spaces of Fontana. They lie nearer to ant, chamber than canal of Schlemm, connect with both, and also with lymph channels of cornea and sclera. Lymph formed in posterior parts escapes through channels near venæ vorticosæ and through optic nerve. Spaces between choroid and sclerotic (supra-choroidal) of peri-choroidal), between globe and capsule (space of Tenon), and between sheaths of optic nerve (supra-vaginal and sub-vaginal) are regarded as lymph-spaces.

#### NERVES OF THE EYE.

(a) Special sense; 2d or optic.
 (b) Motor;
 3d, 4th, 6th, filaments of 5th and sympathetic.
 (c) Sensory; ophthalmic division of 5th. (d)
 Sympathetic branches.

Optic nerve: (p. 5).

Third (motor oculi): supplies sup., inf., int. recti, inf. oblique, and levator palpebræ. Joined by motor nerves of accommodation and sphincter nerves of iris, which are supposed to have separate origin in brain. Sends branch to ciliary ganglion. Receives sympathetic filaments from cavernous plexus.

Fourth (trochlear, patheticus): supplies sup. oblique. Receives sympathetic filaments from carotid plexus. Sometimes blends with ophthalmic. Sometimes sends branch

to lachrymal.

Sixth (abducens): supplies ext. rectus. Receives filaments from carotid plexus, from Meckel's ganglion and from ophthalmic.

Ophthalmic division of 5th: joined by sympathetic filaments from cavernous plexus. Gives off: (1) Lachrymal, which supplies lachrymal gland, conjunctiva, skin upper lid, anastomosing with branches from sup. maxillary and facial. (2) Frontal: a. supra-trochlear to corrugator supercilii, joining with infra-trochlear; b. supra-orbital to upper lid, corrugator and orbicularis, joining with facial. (3) Nasal or naso-ciliaris: a. ganglionic to ciliary ganglion. b. long ciliary, 2-3, joining short ciliary and going to ciliary muscle and iris; c. infra-trochlear to orbicularis, lids, conjunctiva, lachrymal sac and caruncle, joining branch from supra-trochlear.

Sympathetic branches: arise from medulla, cilio-spinal region, cavernous and carotid

plexuses. Join 3d, 4th, 5th, and 6th nerves. Send filaments to dilatator muscle iris, to organic muscles orbit and lids, to ciliary

ganglion and to walls of vessels.

Ophthalmuc, lenticular, or ciliary ganglion; lies in back part of orbit between optic nerve and ext. rectus; reddish color; 1½ in. diameter; receives root from cavernous plexus sympathetic, long root from nasal of ophthalmic, short root from 3d. Gives off short ciliary branches 2-3 in number, which subdivide into about 20, pierce sclerotic about ½ in. from optic nerve and go to ciliary muscle, iris, choroid, and cornea; send fine branches to sheath of optic nerve.

Ascending branches spheno-palatine or Meckel's ganglion, enter orbit by sphenomaxillary fissure, and go to optic and 6th

perves and ophthalmic ganglion.

## APPENDAGES OF THE EVE.

EVERROWS or SUPERCILIA [ Lat. equiv.]:
Arched elevations of skin above orbit covered
with row of short hairs; serve to protect eye
and to influence slightly amount of light admitted. Corrugator supercilii muscle arises
at inner end superciliary ridge and is inserted
into under surface of orbicularis, blending
with occipito-frontalis: supplied by facial and
supra-orbital nerves; draws brow downward
and inward.

EYELIDS or PALPEBRÆ [Lat. equiv.]: Two movable, protecting folds placed before eyes closing entrance to orbit. Upper lid about \$ in., lower about & in. high, measured on inner surface. Space between free margins called palpebral fissure. Outer angle of fissure called external canthus; inner angle, internal canthus [Gr. nav 905, angle of eye]. Small space between lids and globe at inner angle called lacus lacrymalis [Lat. for lachrymal lakel. On edge of each lid about & in. from inner canthus is small elevation, lachrymal papilla, containing minute orifice, punctum [Lat. for small hole], the beginning of a lachrymal canal or canaliculus. Lids composed of skin externally, mucous membrane internally, and, between these, areolar tissue, muscle, cartilage, ligaments, glands, vessels, and Skin is continuous at edge of lid with conjunctiva. Is thin, lax, and contains a few fine hairs. Subcutaneous areolar tissue very loose, and contains sweat glands and hair follicles. Tarsal cartilages, formed of dense fibrous tissue, not true cartilage; lower one elliptical, upper crescentic and larger; orbital margins are thinned and pass into fasciæ (palpebral or tarsal ligamenis) which connect cartilages to edge of orbit; free or ciliary margins thick and straight. Ligament thickened to connect outer angles of cartilages to malar bone and called external palpebral or canthal ligament.

achrymal sac, sending aponeurosis crest of lachrymal bone; then divi wo branches, one going to inner each cartilage. Meibomian glands [Me 7th cent.], variety of cutaneous se lands imbedded in cartilages-30 apper lid, 20-30 in lower; each con plind tube into which open secondary tcini; tubes lie parallel and open in nner lip free border of lid; furnish se ecretion. Conjunctiva [ Lat. conjun join together; mucous membrane ling effected thence upon front of so assing slightly over edge of corneaonjunctivæ [Lat. limbus, a margin] nuous with integument, with mucous leibomian glands, canaliculi, lachry nd nasal duct, and extends through al ducts into lachrymal gland. flected upon eyeball-fornix [ Lat. fo

and there; consists of connective-tissue basis covered by round, cylindrical and flat epithelium; surface traversed in all directions by furrows, and presents papillæ and papilliform elevations, and orifices of follicular glands: retro-tarsal folds present also conglomerate glands called accessory lachrymal glands, and papillæ are here more prominent. Ocular conjunctiva thin and loosely attached to globe; contains few papillæ and no glands; covered by epithelium which extends over cornea. Blood-vessels of conjunctiva chiefly from palpebral and lachrymal arteries; form thick net-work, indirectly connected through episcleral around corneal margin with ciliary system. Lymphatics numerous; form close network around edge of cornea. from 5th pair, enter at inner and outer angles of eye; form thick plexus from which nonmedullated fibres ramify beneath epithelium and end free-some apparently by clubshaped expansion.

Eyelashes, or Cilia [Lat. equiv.]: rows of short, thick hairs on free margins of lids, those of upper lid curving upward, those of lower downward; follicles lie in connective tissue upon cartilage; sebaceous glands con-

nected with follicles lubricate cilia.

Muscles: orbicularis palpebrarum arises from int. angular process frontal, nasal process sup. maxillary in front of lachrymal groove, and ant. surface and borders tendo ocuii;

fibres surround lids and orbits, spreading over temple and cheek. Palpebral portion, arising from tendo oculi, covers lids between subcutaneous areolar tissue and cartilage; fibres unite by cellular raphé at outer angle, some passing into ext, canthal ligament and malar bone. Is sphincter of lids, palpebral portion having involuntary action. Supplied by facial, supra-orbital and sup. maxillary nerves. Tensor tarsi, or Horner's muscle, is part of orbicularis lying behind tendo oculi. Arises from upper 3d lachrymal crest, passes across sac and divides into two slips, one of which inserts into each cartilage near punctum, some fibres surrounding canaliculi and some running along edge of lid to outer angle. Draws lid inward and presses puncta against globe; supplied by facial nerve. Levator palpebræ superioris arises from upper edge optic foramen, runs along roof of orbit, and is inserted into fascia of upper lid around upper edge of cartilage. Raises lid; supplied by 3d nerve. Organic muscular fibres, superior and inferior palpebral muscles, exist in both lids between conjunctiva and cartilage. Supposed to assist in exact closure of lids upon globe; supplied by sympathetic nerves.

Arteries of lids: principal branches from ophthalmic, run along ant. surfaces of cartilages near free edges of lids, forming superior and inferior tarsal arches; from these arches run vessels to skin, muscles, cartilages and

conjunctiva; free anastomosis with angular, ant. temporal, lachrymal, and transverse facial. *Veins* empty into temporal and facial.

Lymphatics empty into facial and sub-

maxillary glands.

Nerves; trifacial to skin and conjunctiva; facial, 3d, and sympathetic, to muscles.

CARUNCULA LACHRYMALIS [Lat. caruncula, a little piece of flesh]: small red body lying on semilunar fold in inner canthus: consists of 13-15 hair-follicles and sebaceous glands, with connective tissue and fat: covered by mucous membrane and has few fine hairs on surface: attached to Tenon's capsule and rectus internus muscle by tendinous fibres, which fact explains sinking of caruncle after division of muscle.

#### LACHRYMAL APPARATUS.

Consists of secreting portion, lachrymal gland, and accessory conjunctival glands; and conducting portion, canaliculi, sac, and nasal duct.

Lachrymal gland: composed of (1) upper portion—shape of almond, lying in fossa at outer angle roof of orbit, attached to bone by tarso-orbital fascia, under surface resting upon eyeball; longest diameter, transverse, about \$\frac{3}{6}\$ in.; weight, 11 gr; (2) lower portion—group small glands arranged in row just above fornix conjunctivæ. Ducts 6-12 in number, very

minute, open in row at outer third upper reflection of conjunctiva. Vessels and nerves enter gland at post. border. Secretion of gland (tears) consists of water, salt and albumen; is spread over ant. surface globe, which it lubricates, by winking of lids; excess collects in lacus, and is forced into canaliculi by orbicularis and Horner's muscles, or flows over cheek. [Under ordinary circumstances tears evaporate, scarcely any passing into nose; and they come mostly from conjunctiva, so that extirpation of lachrymal gland does not materially affect moisture of globe.]

Canaliculi [Lat. for little channels]: two mucous canals 1-1 in. long and about 1 in. diameter, lined by pavement epithelium and enveloped by fibres of Horner's muscle: begin at puncta, run nearly horizontally, and open by common or separate orifices into outer wall lachrymal sac behind palpebral ligament. Lachrymal sac: lies in upper end lachrymal canal between border of lachrymal bone and nasal process sup, maxillary. oval form, flattened antero-posteriorly, about in. long and in. wide. Larger part lies below level of lower inner angle of orbit. Upper part (fundus) is crossed by tarsal ligament, extending about & in. above it. Transition from sac to duct sometimes direct. sometimes interrupted by folds of mucous membrane. Nasal duct: runs in bony lachrymal canal, downward, backward, and outward, curve varying in different subjects; \$\frac{1}{6}-\frac{1}{8}\$ in. long, about \$\frac{1}{8}\$ in. diameter; generally opens in inferior meatus nose, just below attachment inf. turbinated bone, sometimes lower: shape of opening varies with situation. Lined by thick mucous membrane covered with pavement and ciliated epithelium. Enclosed by very vascular network connective-tissue and elastic fibres, and, external to this, tendinous sheath, strengthened above by off-shoots from post. surface palpebral ligament and sheath of Horner's muscle.

Arteries and nerves of lachrymal apparatus are small twigs from neighboring trunks. Gland receives lachrymal artery from ophthalmic, and lachrymal nerve from 5th Nerve governs secretion. [Hence flow of tears from mental states and from injury.]

#### SENILE CHANGES.

Are observed in most of the tissues of the eye. The sclerotic presents calcareous deposits, and a loss of elasticity favoring glaucoma. Cornea becomes smaller and thinner and loses tone; elastic laminæ become brittle and present warty elevations at margins. After 50 (rarely before), arcus senilis [Lat. for senile bow], or gerontoxon [Gr. γερων, cold man, and τοξον, bow], appears, as result of fatty degeneration: begins on upper and lower margins in form of two superficial,

EXAMINATION OF THE E grayish, crescentic opacities with ders indistinct and outer well-def ing rim of clear cornea on or Opacities gradually extend deeper and ends join, forming ring. Choro goes atrophy, becomes rigid and bi presents fatty degeneration and c deposits; vessels become atheroma capillary layer may be partially de membrana limitans thickened. At changes occur in ciliary muscle and pr In relina, sclerosis of nerve-elemen connective tissue occurs, giving white appearance : pigment is bleached an phied, causing uneven color: vessels atheromatous. Lens increases in d loses elasticity and becomes flatter; n assumes amber color, and molecular op appear around it; changes in lenscause radiating opacities: hyaline subs s deposited on post, surface of ant, cap Zounda becomes weakened, favoring dis ion of lens.

# CHAPTER II.

EXAMINATION OF THE EYE.

As a general rule examine every pa thoroughly, no matter what the sympton

1ash Puncta any catar lower race in son ard direct leve paid; the pard; th d. have the Partie the ind the id the iornee in orat dash per facility in the facility of the per the first part of the per the facility of the per the facility of had revered the properties of the state of t on app prate it will be made to it will be found easier to turn it over the su to ver the found easier to turn it over a specific than over the thumb gell, than over the thumb.

and congested by crying, or other causes, simply separating them with the thumb and finger of one hand will often cause their inner

surfaces to be well exposed.

The examination of a child's eye is often very difficult on account of fear, obstinacy, photophobia, spasm of the orbicularis, etc. The child's head should then be firmly held between the surgeon's knees (protected by a towel), while its body is laid across the lap of an attendant, who must also hold its hands and arms. The lids can then be separated by the fingers, or, if not, the upper one can be raised by an elevator. If this is not sufficient, or if the eye is drawn out of view by spasm of the superior rectus, the patient should be etherized. It is always best to make a satisfactory examination at the outset, no matter how difficult or inconvenient it may be to do so. The elevator is sometimes required in other cases where there is great swelling or inflammation of the upper lid.

When the front of the eyeball is red, it is important to know whether the congestion is superficial or deep. In the former case the redness will be conjunctival, and will be shown by a coarse network of vessels running over the sclerotic, or by a more uniform redness which nearly conceals all the white part of the globe. If the congestion and swelling are not very great, the edge of the lower lid rubbed against the globe by the finger may

be seen to move the vessels over the sclerotic. and to press the blood out of them. The inner surfaces of the lids will be congested also, and there will be a mucous or muco-purulent discharge, probably without much photophobia. In deep congestion (ciliary congestion), there is a rosy zone of fine straight vessels radiating from the edge of the cornea; they are immovable, and can be seen by close inspection to lie beneath the conjunctiva in the sclerotic. With this form of congestion, although it may be very slight, there will usually be found pain, dread of light, and a profuse flow of hot tears. This group of symptoms constitutes ciliary irritation, and it indicates an affection of the cornea, or of some of the deeper tissues. Of course the two kinds of congestion are often found combined. When the exit of the venous blood from the interior of the eye is impeded, large, dark, tortuous veins may appear running over the sclerotic, which they penetrate near the edge of the cornea. In certain cases of inflammation, it is important to know whether there is tenderness in the ciliary region—the region immediately surrounding the edge of the cor-To lest this point, have the patient look downward or upward, and make gentle pressure over this region with the tips of the torefingers placed against the lid. (See p. 45.)

Oblique illumination is very useful for examining the cornea, anterior chamber, iris,

be to one side and somewhat in Irc eye examined, on a level with it and feet off. The observer's eye should path of the reflected rays. By milens, the cone of light may be mad erse all parts of the cornea, etc. The ances can be magnified by looking another strong convex lens held d

ances can be magnified by looking another strong convex lens held diffront of the examined eye.

The shape and movements of should be carefully noted. The best observed by excluding the further with a handkerchief, and then a shading and uncovering the exame with the hand. The pupil should promptly when exposed to a bright dilate more slowly when shaded—a taining its circular shape. If influence in the control of the contr

TO TOST OF STANDS OF STAND

at 100 ft., No. 20 at 20 ft., etc. It is custofary to test the acuteness of vision at a cutance of 20 feet. The formula is  $V = \frac{d}{D}$ , which d equals distance at which letters seen, and D distance at which they out to be seen. Thus, if type No. 20 is seen 20 ft.  $V = \frac{20}{20}$ , or 1, the normal standard.

type No. 50 is seen only at 20 ft.  $V = \frac{20}{50}$ .

No. 100 is seen only at 5 ft.  $V = \frac{5}{100}$ , etc. I the illiterate, figures, constructed on sa principle, are used. When V is so reduthat type cannot be read, it is tested by ability to count fingers. The distance which fingers can be counted is noted. The V = fingers at 2 ft., etc. If this cannot be do there may still be perception of light—qualities when there is some perception of fo and outline, or quantitative when only difference between light and dark is appreciated, there is a refractive defect it should be neutrized by glasses to obtain the full value of V

The range (or power) of accommodating the expresses eye's power to adjust itself divergent rays, such as come from near

jects. It is found by formula  $\frac{\mathbf{I}}{A} = \frac{\mathbf{I}}{P} - \frac{\mathbf{I}}{R}$ 

in which P equals distance of nearest point (p) of distinct vision, and R distance of farthest point (r). It is really represented by that convex lens which, if placed at nodal point of eye, would give to rays coming from p a direction as if they came from r. For determining p and r it is customary to use Snellen's or Jaeger's test-types, selecting the smallest that can be distinctly seen. Although all rays which strike the eye are really divergent, those coming from an object 20 feet or more distant are regarded as practically parallel, and such a distance is called infinite. An eye which sees with perfect distinctness at 20 feet or more is said to have its far-point in infinity. An emmetropic eye when at rest is adjusted for parallel rays; its far-point lies in infinity,  $\frac{1}{R} = \frac{1}{\infty}$ . If it can still see distinctly to within a distance of 6 inches, its near point lies at 6 inches, and  $\frac{1}{A} = \frac{1}{6} - \frac{1}{\infty}$ 

 $=\frac{1}{6}$ , or a convex lens of 6 inches focus. The accommodative power of such an eye is always expressed simply by  $\frac{1}{P}$ . A hypermetropic eye may also see distinctly at an

infinite distance, but only by exercising a part of its accommodation; for near objects it must use more accommodation than the emmetropic eye; its total accommodative power is expressed by plus the amount of hypermetropia. Thus, if H= 1 and the near point lies at 8 inches,  $\frac{1}{A} = \frac{1}{8} + \frac{1}{24} = \frac{1}{6}$ . In a myopic eye the far-point corresponds to the myopia; the eye at rest is adjusted for divergent rays; for near objects it uses less accommodation than the emmetropic eye, and its accommodative power is 1 minus the myopia. If the far-point lies at 12 inches-that is, if M = 12, and the near-point lies at 4 inches,  $\frac{1}{A} = \frac{1}{4} - \frac{1}{12} = \frac{1}{6}$ . Thus, in the 3 examples the accommodative power is the same in each, although the near point is different. We distinguish: (1) The absolute range, , where one eye is used. (2) The binocular range, A, where both eyes are used. (3) The relative range,  $\frac{1}{\Lambda}$ , or the range commanded while the convergence of the visual

lines remains unaltered; embracing (a) the

## REFRACTION OF THE EYE.

positive part, lying within the point of convergence, and (b) the negative part, lying beyond the point of convergence. To test the relative range, we may place the object at a definite distance, say 12", and find through what convex and concave glasses it can still be clearly seen. The glasses alter the accommodation without affecting the convergence—the convex measuring the negative part of the relative range, and the concave the positive part, or the accommodative force held in reserve. To do near work comfortably, the positive part should be to the negative as 3 to 2.

The region of accommodation is the distance between the farthest and nearest points of distinct vision. Thus, if r lies at 30" and p at 5", the region is 25". With the same range the region may vary greatly. (Vid.

p. 48.)

Refraction of the Eye.—To determine this, it is necessary to have a case of trial glasses, comprising convex and concave spherical and cylindrical lenses. The rays of light are rendered convergent by the convex, and divergent by the concave spherical glasses. The cylindric lenses act like corresponding spherical glasses in one meridian, and like plane glasses (not bending the rays at all) in the meridian at right angles to this. The latter is called the axis of the glass. The strength of a lens is expressed by a fraction, whose

numerator is one, and whose denominator is the focal length of the lens in inches; the plus sign being prefixed to the convex, and the minus sign to the concave. Thus + 1 represents a convex lens of 6" focus; - a concave lens of 6" focus. (See p. 245.) Cylindric lenses are designated in the same way, with the addition of a c placed after the fraction. Each eye should be tested separately, the other being shaded with a screen without making any pressure upon it. If the patient has normal acuteness of vision not improved by convex or concave glasses, he may be assumed to be emmetropic. If vision is below normal, and improved by concave glasses, he is probably myopic, and the glass which gives him the best vision expresses approximately the degree of his M. If he sees best through convex glasses he is hypermetropic, and the glass which affords the most acute vision expresses approximately his manifest hypermetropia; a part of the defect, called latent hypermetropia, being almost always concealed by the habitual use of the accommodation. Sometimes the whole H. is latent; the patient may have normal acuteness of vision and reject all glasses, or he may even appear to see better through concave glasses, so exalted is the action of the ciliary muscle. Latent H. may always be made manifest by applying a solution of atropia (4 grs. to 3 i.), several times before the examination; it may also be detected with the ophthalmoscope. Where vision is not much improved by glasses, or the patient is uncertain in his choice of them, or miscalls many of the letters, astigmatism. is to be suspected. Very often the sight cannot be raised to the normal standard with any glass, and then amblyopia is associated with the other conditions. (Vide Diseases of

Refraction.)

Field of Vision is bounded by the most eccentric points which can be perceived while visual line remains fixed upon a central point; it comprises the parts seen indirectly, around the central object seen directly. To test it, place patient about 12" from a blackboard, and have him direct the eye to be examined (the other one being covered) toward a small dot or cross marked in centre of board. Take a piece of chalk fastened to the end of a stick, and advance it slowly from edge of board, and mark spot where it is first seen-not as chalk, but merely as something white coming towards the eve. Repeat this in every direction and join the marks by a line. This maps out the quantitative field. By marking in the same way the points where the patient can first recognize the approaching object,-as, for instance, to count fingersthe qualitative field is obtained. By using bits of colored paper, as objects, the different color-fields are obtained. In the normal eye blue has the largest field, red the next, green

and vellow the next. It is essential in these tests that the patient keep his eye fixed upon the central dot during the whole examination. If vision is reduced to perception of light, the patient is made to keep his eye directed straight forward, and a lighted candle is used in the same way as the chalk, to determine the limits of the field. The candle should be shaded with the hand when carried from one point to another, so that the patient will not know from what direction to expect its appearance A convenient and rapid way of testing the field is as follows: Place yourself 2 ft. from the patient, with your eye on a level with his, and directly in front of it; if testing his right eye, for example, have him look steadily with this into your left eye, the other eye of each being closed; then, by using the test object midway between - that is, a foot from each-you can map out the patient's field, and at the same time compare it with your own, which is supposed to be normal.

The field may be concentrically or irregularly contracted, or interrupted by scotomata [Gr. 6noros, darkness] or blind-spots. To test for scotomata, carry the object from various parts of the periphery of the field quite up to its centre, and observe whether there are areas where it is indistinct, or where it disappears from view altogether. Sometimes the right or left half of each field is wanting—homonymous or equilateral hemiopia (Gr.

nut, half. and outs, vision]. Sometimes the outer half of each field is lacking—temporal hemiopia. Sometimes the inner half—nasal hemiopia. In the normal field there is always a blind-spot, corresponding to the optic disc, whose fibres are insensible to light. This is called the blind-spot of Mariotte, after the man who first described it. [Mariotte: France, 17th century.] Under ordinary circumstances it is not noticed, and occasions no inconvenience. Each point of the field corresponds to an opposite part of the retina. There are various instruments (perimeters) for measuring the field, and maps for recording it.

The perception of colors may be defective congenitally or from disease. It is best tested by worsteds, representing the ordinary primary colors and their different shades. A skein of worsted representing one of the primary colors-for instance, green-is laid out, and the patient is directed to put beside it all the samples which seem to him to be of the same color. The other primary colors are used in the same way. Tests which simply require the patient to name the colors are not considered reliable, for the reason that the color-blind learn to name colors correctly from the intensity of their illumination, etc. The worsted-test is known as Holmgren's. [Prof. Holmgren, 19th cent., Sweden.] (Vida p. 171.)

It should be observed whether the object is looked at directly or indirectly. In the former case the image is formed at the yellow spot, and there is said to be central fixation; in the latter case the image is formed on some other part of the retina, and there is eccentric fixation. In eccentric fixation the patient presents the aspect of looking at objects "out of one corner of his eye," as it is commonly expressed.

Having examined each eye separately, it is necessary to find whether the two eyes work in harmony. To do this it is essential to understand the significance of diplopia, and the

action of prisms.

Diplopia [Sendoos, double, and owis, vision], or double vision. If both visual lines are not fixed upon the object, the images are formed on different parts of the two retinge and there is diplopia, or double vision. For example, if the right visual line is fixed upon object, while the left is deviated inward, the latter's image falls upon a part of the retina inside of the yellow spot, and is projected to the outer side in the field, so that it is seen on the left side of the other image. This is homonymous diplopia, each eye seeing its image on the corresponding side. If one eye deviates outward, conditions are reversed, and there is crossed diplopia, right image belonging to left eye, and vice versa. If one eye turns upward, its image appears beneath that of other, etc. In short, double image always appears in direction opposite to that in which eye deviates. The images may be parallel or inclined to one another. Image of deviated eye is called false, that of normally-directed eye being true one. False image is fainter from being formed on a part of retina outside of macula, and therefore less sensitive. When images stand near together, false one is very distinct, and causes intense discomfort-when far apart, it is fainter and produces little or no annoyance, as patient soon ceases to notice it. A slip of red glass may be held before one eye to color one of the images, and so aid patient in distinguishing them. Flame of candle is one of the best test-objects. Diplopia may be constant, when there is fixed squint; or may only appear when eye is moved in certain directions, as when there is only slight inefficiency of a single muscle. Slightest form of it is where images are super-imposed and object appears surrounded by a halo. certain refractive defects there may be two or more images formed in a single eye-causing monocular diplopia or polyopia.

Prisms.—A prism bends the rays of light in the direction of its base, according to size of its angle. If, while regarding an object, a prism is placed before one eye with its base inward, the rays from object will be deviated inward and image will be formed on re-

ins se of macula: there will be Eye will instinctivel some this by rolling outward bring image again upon macula, vision will thus be restored, pro is not too strong. Prisms thus ve testing strength of muscles—th one which can be overcome by t taken as measure of their power. ple, if while looking at an object 12 a prism of 15° with base inwar placed in front of one eye (or a pri in front of each eye) before abilit the double images is lost, we may that prism as measure of power of recti at cistance named. there is diplopia, strength of prism to fuse images becomes a measure Thus, als ation of visual lines. is crossed diplopia, and the images a ed by prism of 15 placed before o with base inward, we say that there is ness of internal recti of 15°. The e) able to unite double images widely sep laterally, but cannot unite those showing than very slight difference in heigh prism of 10° base upward or downw placed before one eye; a diplopia is thus duced which cannot be overcome : im for single vision is annulled and eyes passively to muscles which happen to strongest. This fact is made use of in prism-

test for power of internal recti.

To examine the action of the muscles, patient may be directed to look at a pencil and to follow it with both eyes, without moving his head, while it is carried slowly in various directions through his circle of vision. If a muscle is inefficient, eye may often be seen to waver and lag behind its fellow when turned in direction of such muscle's action. example, if right externus is weak, when pencil is moved to patient's right side the left eve will follow it, but right will not, or will do so in uncertain, faltering manner. The internal recti should be carefully tested as to their converging power: (1) Patient may look at pencil with both eyes while it is gradually advanced to within 4 or 5 inches, surgeon observing whether they remain fixed upon it or deviate outward. (2) While both eyes are fixed upon pencil, one may be covered by hand so as to exclude it from vision but still allow of its being watched: if its internus is weak it may be seen to roll outward as soon as its visual sensation is thus cut off. (3) Draw a fine vertical line upon piece of white paper and in middle of line make a round, black dot \frac{1}{2} inch in diameter. Let patient hold this at his ordinary reading distance and look at it, while a prism of 12°, base upward or downward, is held before one eve. dots, one above other, will then be seen.

muscles are normal, dots will be on same vertical line: if the interni are weak they will be separated laterally and crossed, that of right eye being on left side, and vice versa: in latter case, by placing other prismsbase inward-before eye, the dots may be brought into same vertical line; and strength of prism required for this measures deviation (or weakness of interni) which was present. If images are separated laterally, and homonymous, it shows deficient action of externi; prisms placed base outward before eye will bring them into same vertical line; prism required measuring the muscular weakness. Candle may be used instead of dot. Most common defect of muscular equilibrium is ordinary squint, which is generally discovered at a glance. (Vide Strabismus.) Other defects often so slight as to be very difficult of detection.

Binocular vision. [Lat. bis, twofold, and oculus, eye.] Important to know whether this exists. Simple test is to hold pencil midway between eye and print, while reading. If there is binocular vision, pencil will not interfere with view of any part of page; but if only one eye is used, the pencil will obscure view just in proportion to its size. Or, both eyes being open, hold a prism, base upward or downward before one eye, and if diplopia appears, this proves the existence of binocular vision. Some eyes become so different through disease, or are of such different con-



struction congenitally, as to be independent organs, binocular vision having ceased or never having existed.

## THE OPHTHALMOSCOPE.

When light enters eye, part is absorbed and part reflected outward again through the pupil. The reflected rays retrace precisely the course by which they enter. To see fundus, observer's eye must be placed in path of these rays, without intercepting the source of light. Ordinarily this would be impossible. The difficulty is overcome by the Ophthalmoscope [Gr. op 9aluos, eye, and oneπεω, to look] invented by Helmholtz, 1851, which consists essentially of a small plane or concave mirror with a minute central perforation. Many modifications of the instrument have been made, best one being that of Dr. Loring, of New York. Examination should be made in dark room, with bright, steady light placed at side of patient's head corresponding with eye to be observed, on a level with latter and a little behind it, so that it will be in shadow. Light is received upon mirror and reflected thence into observed eye. Mirror thus becomes a source of light, and observer's eye placed behind the perforation can be directly in path of rays reflected from fundus of eye observed. Pupil

may be dilated, if necessary, by a weak sol. atropia (gr. j. to 3 viij.). Two methods of examination; the indirect (or inverted image). and the direct (or erect image). In former, the surgeon holds mirror close before his eve and illuminates eye observed from distance of about 12": with the other hand a 21 inch biconvex object-lens is held vertically before observed eye so that pupil lies about in its focus; lens may be steadied by resting a finger against patient's forehead, and another finger may be used to raise upper lid if required. An enlarged, inverted image of fundus is thus formed between lens and observer; image may be further magnified by using a weaker object-lens (3½-4'), or by placing an 8-10" convex lens behind mirror. Optic disc is best brought into view when patient directs his eye a little toward nasal side of centre; the macula, when he looks straight ahead. In direct method no object-lens is used, and observer approaches to within I or 2 inches, using eye corresponding to the one he examines, and relaxing his accommodation as if he were looking into infinite distance. Image is erect, and apparently behind patient's eye; it is larger than inverted image, but field of vision is smaller, direct method being preferable for minute and accurate examination of details, the indirect for a general survey of whole fundus.

In examining an eye with ophthalmoscope,

the media should be first observed from a distance of 12-18". If observed eye is moved in all directions, and especially if pupil is dilated also, no opacity of media need escape detection. For detecting very minute opacities, a magnifying glass of 3 or 4 inches focus may be used behind the ophthalmoscopic mirror, taking care to have the part examined about at the focus of the glass. With the ophthalmoscope, opacities of the media usually appear black against a red background, while by oblique illumination they have a grayish

aspect.

If the media are clear, the pupil is filled by a brilliant yellowish-red reflex from the retinal and choroidal vessels, more or less modified by the amount of pigment present. Appearances of fundus vary greatly within limits of health. Optic papilla (vide p. 6) generally appears as round or vertically-oval disc, about in, to inner side of posterior pole, slightly prominent, of yellowish-white color (most marked on inner half), often bordered by pigment and by whitish connective-tissue ring, and marked by white striæ from trabeculæ of lamina cribrosa. Central vessels radiate from its centre into retina (vide p. 21), arteries of bright color and straight course, with light streak along centre; veins larger, darker, and more tortuous. Venous pulsation appears on disc, or, if not, is easily produced by slight pressure upon globe. Arterial pulsation not observable in normal states. Near centre of disc is white, glistening physiological excavation, generally small and shallow, with sloping edges over which vessels are seen to dip; sometimes it is large or has sharp edges. Retina is too transparent to be easily seen; seen best in dark eyes, especially in those of negroes, where it may appear as grayish film. Macula lutea should be found 2 diameters of papilla to outer side of same, and on level with its lower half; it appears as roundish spot, more deeply colored than rest of fundus, with a bright yellow spot, the fovea centralis, in its centre. The region is marked by an absence of blood-vessels. The pigmented cells may be seen as small dots uniformly studding the fundus, and giving it a granular appearance. In light eyes vessels of choroidal stroma may be seen as bright red bands enclosing intervascular spaces, and even finer vessels and venæ vorticosæ may appear. In dark eyes choroidal vessels may be completely hidden, and fundus may have mosaic appearance from abundance of pigment.

In what has been said of direct method it is assumed that eyes of both patient and observer are emmetropic, and with accommodation relaxed—that is, adjusted for parallel rays. Then, rays which emerge from illuminated fundus of patient's eye and enter observer's eye are parallel, and latter obtains a distinct

image, although object is but two or three inches away. If eye observed is not in condition assumed, direction of the rays is altered accordingly, and image naturally indistinct. In myopia, emerging rays are convergent: a concave glass must be placed behind hole in mirror to render them parallel before entering observer's eye, in order to give him a clear image. In hypermetropia a convex glass must be similarly used. Glasses thus required to give clear image-that is, to render rays parallel, as in emmetropia, become also a measure of existing departure from emmetropia, or of the refractive-defect. If observer is not emmetropic, he can correct his defect by proper glass, and then proceed as if he were an emmetrope. If he cannot fully relax his accommodation, he is practically myopic to amount used—that is, his eye is adjusted for divergent rays. The amount used is generally the same, and can be found by experiment, Having found this, observer should proceed as if he had myopia of that degree. In making calculations, observer's defect must always be allowed for.

Such, in brief, are the principles on which direct method becomes so useful for measuring refraction of observed eye. It is valuable aid to other means, not substitute for them. This method also used for making measurements in depths of fundus, as of inflammatory swellings, tumors, etc., on principle that a

certain refraction corresponds to a certain length of antero-posterior axis. For full explanation of whole subject see Mauthner's Lehrbuch Ophthalmoscopie, chap, vi.; also "Determination of the Refraction of the Eye with the Ophthalmoscope," by Dr. Loring. Dr. Loring's Ophthalmoscope is furnished with a circular metal disc containing small convex and concave lenses, running from the weakest to the strongest numbers. The disc fits upon back of mirror; and by rotating it, any glass required can be brought opposite the sight-hole.

## THERAPEUTICS OF THE EYE.

Comprise both local and general means. Latter very important. Many ocular diseases result from syphilis, rheumatism, Bright's disease, gout, etc., and will not recover without appropriate general medication. Surgeon's hands and instruments should be scrupulously clean, and never carried from one eye to another without washing. Rags and brushes used on one eye should never touch another. Poultices are a very common application among those who prescribe for themselves, and are almost always injurious. As a rule, they should be avoided. Lead-lotions are dangerous, as, in ulcerative diseases of the cornea, they may be deposited as insolu-

ble precipitates in the corneal tissue, forming white opacities. Cleanliness; good hygiene; rest of eyes; avoidance of bright light, wind, dust, smoke, etc., are prescriptions of almost universal application in ocular diseases. In syphilitic affections the mercury is often given by inunction to secure a rapid effect. Anodynes are used as in disorders of other parts of the body. The following local meas-

ures are of very extensive use:

The protective or compress bandage: Used to exclude eye from injurious influences, to support and keep it at rest. To apply it, lay small piece of soft linen over the closed lids, and upon this spread charpie or cotton enough to fill the orbital hollow, regulating amount according to object in view, and being careful to distribute it in such way that its pressure will be uniform. This is held in place by flannel roller, t\(\frac{1}{2}\) inches wide, applied by alternating turns, first around forehead and then down under occiput and over eye, and fastened securely by pins.

Eye-shades: Often used as protection from light and wind. Best made of thick paper or pasteboard covered with black or blue silk and fastened by tape running around head.

Protective spectacles: These are of various inds. Those with wire sides which exclude entilation and keep the eye confined in an mosphere of its own exhalations are objectivable.

effects appear in few minutes and last several days. It acts on the peripheral ends of the nerves, paralyzing the filaments of the oculomotor and stimulating those of the sympathetic (?). Pupil first dilates, and then accommodation gradually becomes paralyzed. Form employed is solution of 1-4 grs. to water 3i., and this is sufficient for all ordinary use. Very weak solution (gr. 1 to 3i.) dilates pupil without much effect on accommodation. and is thus useful for making ophthalmoscopic examination. Atropinized gelatine and paper are sold, and are very convenient. Patient should always be told beforehand of effects of drug, else he will be frightened and accuse surgeon of "putting out his eyes." In some cases atropine has poisonous effect, shown by increase of inflammation, pain, irritation of lids and conjunctiva, eczematous eruption, etc., and has to be discontinued. ( gr. sulph. zinc added to each ounce of sol. will often prevent this.) Its local use often causes unpleasant feeling of dryness and constriction about the throat. Very rarely it causes alarming symptoms of belladonna poisoning. Morphine is proper antidote.

Duboisine (the active principle of Duboisia myoporoides) produces the same effects as atropine, but acts more powerfully. It is used in solutions of the same strength as at-

ropine.

Myotics, or agents which contract pupil,

are of more limited application. Calabar bean is a type. It contracts the pupil and causes spasm of ciliary muscle. It will overcome weak sol, atropine, but not a strong one, and its effects are brief. Sulphate of physostigmine and sulphate of eserine-both alkaloids of calabar bean-are the myotics most commonly employed. Eserine is useful in much the same cases as atropine, excepting iritis, and sometimes agrees where atropine does not. It is said to contract the vessels, to lower the intra-ocular pressure, and to lessen diapedesis. (Vide Glaucoma.) It sometimes causes irritation. Both eserine and physostigmine have been highly recommended for suppurative diseases of the cor-

Pilocarpine (the active principle of jaborandi) is similar to eserine in its effects on the eye, but is not so useful. Used hypodermically (hydrochlorate of pilocarpine, dose to ½ gr.), as an alterative and absorbent, it is thought to act favorably in episcleritis, and for clearing up vitreous opacities. Used in this way it sometimes produces alarming prostration, accompanied by vertigo, nausea, and vomiting. It also causes sweating, sali-

vation, and lachrymation.

Eserine, physostigmine, and pilocarpine are used locally in solutions of 1 to 4 grains to the ounce. Atropinized and calabarized gelatine discs are sold in the shops.

## ASTRINGENTS.

Britants, astringents, and caustics; fol-

leaving used most commonly:

Previously calonel; applied by dusting it into eye from camel's-hair brush while lids are held apart by fingers. Brush should not used eye, and powder should be fine and not used in excess, lest it form lumps, and cause

too great irritation.

Continents of end or yellow exide of mercury, or of exide of zinc (each gr. 1-10 to 31), solutions of tannin and glycerine; applied on inner surface of lid by brush, or small spatula, and spread over globe by lids. Also applied to edges of lids for blepharitis, exc.

Crystals of sulphate of copper (blue-stone) and of alume, out into smooth and convenient became equal barts sulphate copper, nitrate branch and alum moulded into sticks (lapis divisors); mangated or solid stick nitrate of sittor; are applied to palpebral conjunctiva

by everting lids.

Solutions mitrate of silver (gr. 1-40 to § i.) are applied to palpebral conjunctiva with brush or cotton wound on stick. After making an astringent or caustic application, it is customary to wash off the surface treated with the surface treated with the surface treated with the case of nitrate of silver, a little salt and water, in order to neutralize any excess of the remedy.

Latient or washes (collyria) are often given to patient for his own use at home.

The most common astringent collyria are those of sulphate of zinc, or alum, or copper (gr. 1-2 to 3 i.).

For bathing the eyes, a solution of salt and water, or of borax and water (3 i. to Oi.), is

very useful.

Where there are irritating discharges and sticking together of lids, simple cerate, vaseline, etc., are given, to be smeared along edges of lids.

Other applications, which have not been mentioned here, are used by different sur-

geons.

Exclusion from light. The amount of light to be allowed to a case of ophthalmic disease is often an embarrassing question. Many patients shrink from the light, when to indulge their propensity would be ruinous. The tendency of the laity is toward too much exclusion. As a general rule, the more light and fresh air, consistent with safety, the better for the case.

## SURGERY OF THE EYE.

The following are the principal operations performed. The lids are held apart, when necessary, by a spring-speculum, and the eyeball kept in position by a fixation-forceps,

through cornea, and knine and entered perpendicularly, so as to divid by shortest route and not run betw laminæ. When point of instrument tered ant. chamber, it should be turn ward, and carefully watched lest it wo or lens. Incisions in ciliary region ar avoided, on account of risk of sympophthalmia. Blood-clots, etc. best refrom incision on front of eye, by gent bing lids over it; or by fine forceps.

ping lids over it; or by fine forceps.

Paracentesis of cornea: perform passing needle, or blade of iride knife, through cornea near marg allowing aqueous humor to drain of alongside of instrument. In this, and operations where anterior chamber is a too rapid escape of fluid must be through fear of prolapse of iris, and rious shock which results from too diminution of intra-ocular tension.

Incision may be kept open by passing fine probe through it every day or two, and ocular tension so kept down until process of repair begins. This operation is done also

for corneal abscess.

Trephining of cornea [Bowman, London, 1872] is done by an instrument specially designed for the purpose. A circular disc of corneal tissue is removed, Descemet's membrane being generally left behind, if possible.

Iridectomy [Gr. 1015, and exroun, cutting out ]. [Done by Wenzel, in 1780.] The iridectomy-knife is entered through cornea near its edge, carried on until incision is of desired length, and then withdrawn. Iris-forceps then passed through incision, made to grasp iris and draw it out, when desired amount is cut

off by scissors close to lips of wound.

Iridodesis [Gr. 1915, and Sew, to bind]. Iridenkleisis [Gr. ipis, and eyuleiw, to include |. A small iridectomy-incision is made, and over this is laid loop of fine silk, Iris is caught by blunt hook and pulled out through incision and loop. Ends of latter then pulled and tied. Tissue thus strangulated drops off in 24-48 hrs. generally. Sometimes no loop is used, iris being merely left caught between lips of wound. Operation now seldom performed. Proposed by Critchett.

Iridotomy [Gr. 1915, and roun, section], or Iritomy. Done by Cheselden, England, 1728.1 Done chiefly where iris has formed adhesions to cornea or lens, and pu closed by inflammatory deposit. The of the operation is to make a slit in the with the hope that its edges will retract, ing a permanent opening to serve as a pupil. Sometimes the slit is made sim a knife passed through the cornea and Special instruments have been devised foperation, such as the scissors of A

Wecker [Paris, 19th cent.].

Corelysis [Gr. nopn, pupil, and i loosing]. [Wenzel.] Performed to bre adhesions which have formed between th and the capsule of the lens. An openi made near corneal margin, a little to on of adhesion which it is proposed to lo Blunt, flattened hook then passed in made to tear through attachment. (Si field's method.) Or, an incision having made near the edge of the cornea, the i grasped, by a pair of curved forceps, nea adhesion, which is then loosened by tra made toward the periphery. (Passay method.)

## CATARACT OPERATIONS.

Keratony.xis [κερας, cornea, and re to puncture], Discission, or solution of ract. [Conradi, Germany, 1797.] Appli only to soft cataracts. Consists in lacer anterior capsule by fine needle pass through peripheral portion of cornea. Aqueous humor thus comes in contact with lens matter and softens it so that it is gradually absorbed. Operation generally has to be repeated several times. Best to lacerate capsule and lens very slightly, especially at first sitting, else great swelling of lens-matter may result, causing injurious pressure. Pupil should be dilated with atropine before operation. Soft cataracts also removed through linear incision made at edge of cornea; may escape spontaneously as soon as wound is completed, or require to be coaxed out in same manner as hard cataracts, or to be removed by curette. When there is great swelling of lens after keratonyxis, it should be evacuated at once through a linear incision. Soft cataracts are sometimes evacuated by suction. A suction-instrument has been devised for this purpose, which can be passed through a small opening in the cornea.

The operation of Extraction is designed for the removal of hard cataracts. It has completely supplanted the old and dangerous operation of reclination or couching, by which the lens was pushed down into the vitreous humor and left there. The chief credit of introducing extraction is given to Jacques Daviel [France, 1745], although others had

performed the operation before.

Flap-extraction is performed by a section made either upward or downward at margin.

CATARACT OPERATIONS. of cornea, so that about half cornea is con prised in flap. Capsule next opened by cy. totome. Then gentle pressure is made with the property of the pressure is made with the pressure finger or a curette against globe opposite flar so as to tip edge of lens forward into wound

Graces modified linear extraction [Al brecht I on Gracfe, Berlin, died, 1870], it self somewhat modified since he first proposed it, is the most common operation for hard The incision is smaller than in the flap-operation, and may be regulated by the size and hardness of the lens. The operation is usually performed somewhat as follows: The point of a narrow-bladed knife (a Graefe knife) is passed through the sclera just behind the edge of the cornea, and a little above its centre, carried across the anterior chamber and out at a corresponding point on the opposite side. The first puncture is made with the point of the knife directed downward toward the centre of the pupil, so that the inner lip of the wound may be as large as possible. After completing the puncture and counter-puncture, the edge of the knife is turned obliquely upward and forward, and, by a sawing motion, made to cut its way out, emerging about at the upper sclero-corneal margin. A Diece of iris is drawn out and totome, preferably by a T-shaped incision or The lens The capsule is divided by the cysby an incision along the periphery. The lens

is tipped forward into the track of the wound, generally by pressure with the curette at the opposite corneal margin; then, by gently sliding the curette over the cornea, the lens is forced out. The incision is made either upward or downward.

Liebreich's operation [Liebreich, London, 19th cent.]. Incision is made with narrow-bladed knife, is more transverse than in Graefe's operation, lying wholly in cornea, except puncture and counter-puncture, which are made in sclerotic about 1 mm, from its

edge. No iridectomy is performed.

A cataract-extraction is sometimes divided between two operations. At the first an iridectomy is performed; then, at some subsequent time, the lens is removed. This is called Jacobson's method [Jacobson, Königsberg, 19th cent.]. In certain forms of cataract the lens is extracted in its capsule by passing a curette behind it.

Operations for secondary cataracts (see p. 134) consist usually in making a small hole through the membrane by tearing it with needles (called a needling) or forceps, or by cutting it with a knife or a special form of

scissors.

Many modifications of the operation for cataract have been proposed which are not

mentioned here.

During all operations involving corneal incision, iris may fall forward into wound, and if it cannot be replaced, the prolapsed part must be snipped off with scissors. It is a cardinal rule never to leave any iris entangled in the lips of an incision. After escape of a cataract a few drops of vitreous may follow, but if eye is closed and bandaged at once, recovery may occur without bad consequences. Still a loss of vitreous is to be regarded as an unfavorable occurrence. It is apt to be attended by detachment of the retina and by intra-ocular hemorrhage.

Strabismus-operation: Tenotomy: Strabotomy [Dieffenbach, Germany, 1839]: fold of conjunctiva and sub-conjunctival tissue is seized by the forceps near margin of cornea and over insertion of tendon to be divided. This fold is snipped by blunt-pointed scissors, curved on the flat, which are then passed into the opening by a burrowing motion. made to thoroughly divide the sub-conjunctival tissue about the insertion of the muscle. Strabismus-hook is inserted and passed under tendon so as to catch it up, after which it is brought into view by pushing aside conjunctiva. While held on hook, it is divided by scissors close to its insertion. Another hook is then inserted and moved freely around, and any remaining fibres caught up and divided in same way. There are several minor modifications of this method of operation. The wound in the conjunctiva is united by sutures when desired. There are certain ways of applying sutures for the purpose of lessening or increasing the effect of the teno-

tomy when necessary.

Advancement of insertion of a muscle .-An incision is made in conjunctiva, 1-2 lines from edge of cornea and over tendon of muscle. Tissues, including muscle (whose insertion is first divided), are dissected up from the sclerotic as far back as equator of eyeball. Flap thus formed is pulled forward and united by sutures to flap left standing at corneal margin, so as to cause the tendon to unite itself with the sclerotic at a point farther forward. Sometimes a piece of the muscle is excised so as to shorten it. If some conjunctiva is excised before bringing flaps together, effect is increased. Tendon of opposite muscle usually divided also, to increase effect. The operation is modified in several ways by different surgeons.

Bowman's operation for opening the canaliculi [Bowman, London, 19th cent.]. A fine director is passed into punctum and along canaliculus into sac, its groove turned toward free margin of lid, which is kept tense by being pulled outward with finger. Point of narrow-bladed knife then inserted into punctum and passed along director so as to lay open canal quite up to sac. Or a narrow, probe-pointed knife is passed into punctum and along canaliculus, which is divided by raising knife from heel to point, no director

being used. Latter is most common method. Sometimes the knife is passed onward through the nasal duct for the purpose of dividing

strictures.

Probing the nasal duct is done by Bowman's probes, which are of different sizes and bent to correspond with course of duct. Edge of lid is kept on the stretch as before. End of the probe is passed along divided canaliculus until it is felt to strike hard inner wall of sac. It is then raised into vertical position with convexity of its bend backward, and passed downward through sac, and then downward, outward, and forward through duct into nose. When end of probe is not in sac, each movement of it will be seen to cause a movement of overlying skin, and it will not give to the finger the sensation of striking against the firm bony wall, as it does when in proper position.

The exact manner of passing lachrymal probes, the amount of force to be used, etc.,

can only be acquired by experience.

Canthoplasty. Division of outer canthus.—Pass one blade of strong scissors behind commissure to bottom of cul-de-sac, and other in front, and divide commissure by one sharp cut, incision being exactly horizontal. Conjunctival surfaces of wound then joined to cut edges of skin by three or four fine sutures, one above, one below, and one at outer angle being usually sufficient. After making first

incision some recommend to put upper lid on stretch by pulling it toward nose and to divide upper canthal ligament by a nick with scissors, at right angles to incision, nick being made about two lines from temporal border of orbit [Dr. Agnew, New York]. A simple incision of the canthus without sutures is

more properly called canthotomy.

Operation for Entropion.—The most common one is the Jaesche-Arlt operation or a modification of it :- A horn spatula is placed under the upper lid, and, by traction on the skin, the edge of the lid is rolled upward and outward. An incision is made along the edge of the lid, from near the punctum lacrymale to the outer angle, dividing it into two layers, the outer containing the cilia and their bulbs, the inner the conjunctiva and cartilage. The incision is about a inch deep. A strip of skin, somewhat oval in shape, is then excised from just above the margin of the lid and running its whole length. The edges of the wound are united by sutures, and this rolls the anterior lip of the split border, containing the eyelashes, outward. Sometimes a strip of orbicularis muscle and a wedge-shaped piece of the cartilage are excised with the fold of skin. The bridge of skin containing the lashes is sometimes separated from the underlying tissue, so that it can be moved upward and so transplanted to a higher point as the edges of the wound in the integument are director together. A canthoplesty is often done asso. Other operations are also done for this designation. The operations for extrapion are minureness, and vary with the special requirements of the case.

Sensitioning or excitate of evolute [Bonnest (Sec.) : Conjunction seized with forceps and finding all acound comes quite close to its edge, by circular mossion, with bluntpointed scissors, curved on flat. Tendons of muscles picked up successively by strabismus-hook and divided close to sclerotic. Electric them drawn over to one side by forcess, and sessoes (with curve toward eyeball nessed back along its surface to optic nerve. Blades then opened and made to divide nerve close to scientic. Usually the bemorrhage is slight, and is easily controlled by pressing a sponge for a short time upon the bleeding points. When it has ceased the his are closed and cold cloths applied. Packing write with sponges, ice, etc., usually needless. A compress-bandage is useful where there is a tendency to great swelling and eochymoses of lids. By this operation orbital tissue and muscles are left behind to form good, movable stump for artificial eye. In certain conditions, as of malignant disease, etc., a considerable piece of the optic nerve is sometimes excised with the eveball.

Artificial eyes may be worn after wound has cicatrized and all irritation ceased. It is

best to begin to fit them a few days after the enucleation, so as to prevent contraction of the orbital cavity, and to give it a good shape. They should be worn at short intervals at first until parts become used to the foreign body. If sympathetic trouble has existed in other eye, take extra caution lest artificial eye be worn too soon. Must not be worn too long without renewal, as they become rough and irritating. Often give rise to severe conjunctivitis of stump, and sometimes to sympathetic irritation of other eye. Shells are made to wear over shrunken eyeballs where no enucleation is performed.

Some operations not described in this chapter will be found under their appropriate head-

ings in other parts of book.

The after-treatment of operations requires special attention and study. After the principal operations upon the eyeball, it is customary to use atropine or eserine, according to indications, to apply compress bandage over both eyes, and to keep patient quiet in bed, with more or less seclusion from light. When desirable to keep eye closed for several days, the surgeon can judge of its condition, to a certain extent, from appearance of lids. If lids are red, swollen, and ædematous, this may be regarded as an unfavorable indication regarding the parts beneath. A purulent discharge is also a bad sign. If severe inflammatory reaction occurs, antiphlogistic treatments.

by leeches, iced cloths, etc., is employed. The operations on the lids, muscles, tear-passages, etc., usually require nothing more than a water-dressing, and often not even that.

# CHAPTER III.

## DISEASES OF THE EYE.

## ORBIT.

THE ORBIT has close relations, through membranes and vessels, with nose, antrum, cranial cavity, and temporal fossa. Its discases, therefore, are not always independent. They are not usually limited to a single tissue, but so classified for convenience. The symptom common to many orbital diseases is exophthalmos or protrusion of the eyeball. It may be hardly perceptible, or so severe that lids cannot close, and exposed cornea sloughs and allows contents of eye to escape. Rarely globe may be forced entirely out and lie upon cheek. With protrusion there is redness and ædematous swelling of conjunctiva and lids, mobility of globe is impaired, and nerves may be paralyzed from pressure. Vision is impaired according to tension and pressure upon optic nerve and ocular tunics.

INJURIES: Generally due to incised or punctured wounds or to foreign bodies. May

orbital abscess periostitis, hemorrhage, ysema, fracture of bony walls, injury of Il, and even extrusion of it. Results appear at once, or not until some time accident. Fractures of roof and inner very dangerous from injury to brain. ign bodies should always be removed if cted. Best place for incision, either for loration or removal, is through conjunc-, between eyeball and lid. Outer canthus y be divided to give more room for manipuions. Parts should be kept at rest, and id and leeches used to check inflamma-If eye is extruded it may be replaced id compress bandage applied. Incised id punctured wounds treated as in other ırts.

PRESSURE UPON ORBIT, with tumor at uper inner angle, and displacement of eye wnwards and outwards, is sometimes caused distention of frontal sinus. Tumor, if left itself, may burst into nose, orbit, or through

per lid.

EMPHYSEMA: Usually from fracture ethoid cells or frontal sinus, or rupture lachryal sac. Air enters cellular tissue of orbit d lids, causing elastic, crepitating swelling, d exophthalmos. Generally disappears unr gentle pressure.

HEMORRHAGES: Chiefly from injury; somenes spontaneous or due to straining.

mosis may appear in lids and und

junctiva some time after accident. May cause exceptibalmos and injurious pressure. Feet treatment is to assist absorption by cold compresses and firm bandage. Incisions may be made where symptoms are urgent.

ARRES: ORBITAL CELLULITIS: Caused by wounds, foreign bodies, disease of bone, cold. operations on eye, extension of inflammatton from other parts, severe constitaisonal disease. Symptoms almost always scatto, reaching crisis in 8-14 days. Lids red, he. and swollen: intense pain, increased by pressure against globe; fever, and perhaps han-simploms. Exophthalmos generally directly forward. Sight may be impaired from pressure on optic nerve, which may cases cases generat and neuritis. When pus forms, fluctuation may be found behind lids, and alteress may burst through lids or conmaries. Prograssis guarded, on account of meningitis, and permanent Antiphlogistics in early singles : suppuration occurs, poultices, and conjunctiva between lids and increasory incision is proper when in pus, and it is always better to we know the early than too late.

INFLAMMATION OF TENON'S CAPSULE occonsistent rarely. Caused by cold, strabismus operations and ophthalmitis. Produces pain; and redness of conjunctiva, and, to have extent, of lids; with perhaps slight exophthalmos. Leeches and ice-compresses

may be used in early stages.

Periostitis is generally limited and due to cold, injury, foreign bodies, or is secondary to inflammation of other parts. In acute form there is severe pain and local tenderness on pressure against bony wall. Swelling and redness of lids and perhaps slight exophthalmos—generally towards one side. Sometimes fever. Pus may form beneath periosteum, and necrosis may result. General treatment is that of cellulitis. In chronic form, which is generally due to syphilis, symptoms are less marked. Pain apt to be worse at night. Nodes and exostoses may develop. Treatment should be that for syphilis.

CARIES AND NECROSIS result from injury, periostitis, cellulitis, syphilis, tuberculous and scrofulous cachexiæ. Cause sluggish, œdematous, inflammatory swelling of lids, which points and discharges foul pus. Fistulous opening marked by unhealthy granulations, and dead bone may be felt by probe. Pus should be evacuated as soon as possible and opening enlarged, when necessary, for removal or escape of exfoliated bone. Sinus should be kept open and clean until it can heal from bottom. In healing process there is apt to be cicatricial contraction of lid, leav-

ing severe ectropion.

TRUE ANEURISM may arise from ophthalmic artery or its branches, causing protrusion and pulsation of globe. Pain generally

slight.

DIFFUSE OR FALSE ANEURISM much more frequent. Caused by rupture of artery from injury or disease with sudden escape of blood into orbital tissue. May supervene upon true aneurism. There is immediate pain and exophthalmos. Latter increases, with redness and swelling of globe and lids; and elastic pulsating tumor appears at edge of orbit. Pulsation stopped by pressure on carotid. Whirring noise in head, audible with or without stethoscope. Only treatment for true and false aneurisms is by compression or ligature of carotid.

ANEURISM BY ANASTOMOSIS: rare; generally congenital and found in children. Most often situated in subcutaneous tissue of anterior part of orbit. Consists of group of dilated vessels forming irregular, doughy tumor with pulsation and thrill-not much affected by pressure on carotid. Best treatment is by

subcutaneous ligature or electrolysis.

TUMORS of orbit are of same kind, benign and malignant, as are found in other parts of body. May arise in orbit or invade it from eyeball or from neighboring parts. Cause exophthalmos, and its injurious consequences. Malignant tumors are of more rapid growth than benign, and involve general health. Tumors should be excised, when there is any prospect of benefit from operation-if possible without sacrificing eyeball. It is often necessary, however, to remove latter also, even when considerable vision remains to it.

A form of exophthalmos of both eyes, without much loss of vision, associated with cardiac disturbance and enlargement of thyroid gland, occurs in Basedow's or Graves' disease, or Exophthalmic Goitre. There is a peculiar staring appearance of eyes, and the upper lid does not follow the globe normally in the downward movements of the latter.

## CONJUNCTIVA.

FOREIGN BODIES upon conjunctiva cause marked irritation, congestion, and lachrymation, or flow of tears. [Lat. lacryma, tear]; together with spasmodic closure of lids, pain and gritty sensations. May be washed away by free flow of tears excited, or require removal. Ocular and palpebral conjunctiva must be thoroughly exposed and examined,—by magnifying glass if necessary (Vide p. 41). Foreign body easily removed by bit of soft cloth; or, if deeply embedded, by spud or forceps.

Sand, bits of broken glass, etc., may be washed away by stream of lukewarm water. Sensation of foreign body may persist for some

time after its removal.

Injuries from lime, mortar, acids, hot fluids etc., cause excoriation, sloughing; and, in healing, cicatricial contractions. Eyes should be carefully washed with warm water, and soothing applications made—olive oil being

very useful one. If patient is seen at once, lime may be neutralized by vinegar and water (3 i. to 3 i.); acids by solution of soda (3 i. to 3 iv.). After-effects treated *pro re nata*. Astringents to be avoided where excoriations exist. Atropine nearly always useful.

ECCHYMOSIS: occurs from rupture of vessels by injury, or violent exertion, such as sneezing; during scurry and Bright's disease; in course of inflammations; without any apparent cause; or may extend forward from orbit,—usually some time after accident. Treatment by cold water or slightly stimulating lotion (Tinc. arnicæ 3 i., Aquæ 3 iv.).

**ŒDEMA**: frequent in inflammation; occurs spontaneously in debility, old age, kidney-disease. Compress bandage and mild astringent

wash are sometimes employed.

EMPHYSEMA: occurs, rarely, from fracture of nose or rupture lachrymal sac. Causes crepitating swelling. Pressure bandage.

CONJUNCTIVITIS: inflammation of conjunctiva: May be divided for convenience into following varieties:—

(I) Catarrhal.

(2) Purulent. (3) Gonorrhæal.

(4) Diphtheritic.

(5) Granular.

(6) Phlyctenular.

Classification is arbitrary; one form may run into another; and discharge from one form may reproduce that form or a different one. First five forms contagious and infectious, and may occur epidemically. Differen-

tial diagnosis often impossible at first.

Catarrhal Conjunctivitis: Catarrhal Ophthalmia: Mildest form. Caused by injuries. exposure, bad hygiene, exanthematous diseases, &c.; may be secondary to other inflammations; in rare cases appears due to errors of refraction. Symptoms: Smarting, itching, sensation as of sand in the eye, lachrymation; increased vascularity, causing partial or uniform redness of globe and giving to inner surface of lids rough, velvety appearance: ædematous swelling of membrane and subjacent tissue, chemosis, [Gr. xnun, a gaping? | which, if severe, may rise above level of cornea causing it to appear sunken: redness. swelling and stiffness of lids; mucous or muco-purulent discharge, with tendency to gluing together of lids, especially in morning. Usually attacks both eyes at once. Amenable to treatment, and not very apt to invade cornea. (See p. 42.)

Treatment: In this (and in all other forms) extreme cleanliness as regards patient, and all towels, utensils, etc., used by him, with isolation if necessary; hygienic precautions and attention to general health. Locally, mild astringent lotion every few hours. A caustic applied at very outset may shorten attack.

Cold applications in early stage.

dency to shrinking and cicatrices of conjunctiva in healing. Cornea apt to suffer, Constitutional disturbance often marked. Very destructive. Rare in the U. S. and England. Treatment not very effectual. Ice-compresses, leeches, &c., in first stage. Astringents, and caustics in purulent stage. Atropia throughout. Support of general sys-

tem.

Granular conjunctivitis; Granular ophthalmia: Granular lids: Trachoma: Generally a result of one of the above-described inflammations, and essentially a chronic condition, although sometimes associated with acute symptoms. Granulations almost entirely confined to palpebral conjunctiva, chiefly two kinds: (1) Enlarged conjunctival papillæ; (2) "Frog-spawn granulations," grayish bodies, looking like sago-grains, and composed of lymphoid cells and connective tissue. Both varieties may be seen separately, but more often mingled. Symptoms those of annoying chronic conjunctivitis, more or less severe. If process not checked, cornea falls into state of ulceration and vascularity, from constant friction of rough lids upon it; conjunctiva and tissues of lids may become atrophied and cicatricial, leading to entropion, symblepharon, xerophthalmia, etc. Disease is often associated with low general health, and bad hygiene. Runs tedious course. Treatment: Locally, astringents and caustics-sulphate of ner of origin, from any other purulent conjunctivitis. An extremely virulent, purulent inflammation, caused by inoculation from urethral discharge. May destroy eye in few hours.

Conjunctivitis in newly-born: Ophthalmia neonatorum [Gr. veos, new, and Lat. natus, born]: catarrhal or purulent conjunctivitis of infants, usually appearing shortly after birth, and caused by contact with vaginal discharges of mother; may also occur from other causes, as exposure, filth, &c., and not appear until several weeks after birth. All grades of severity.

Treatment: same as in similar inflammations of adult, regulated by severity of attack, It is believed by many that, in infants, caustics are needless and injurious; and that a mild

astringent application is sufficient.

Diphtheritic conjunctivitis: Occurs in course of diphtheria, and also results from same causes as other forms. Begins with great heat, redness, swelling, and tenderness of lids, with rigidity from fibrinous infiltration. Firm swelling of conjunctiva from same cause, and pale, smooth, glistening appearance of its surface. Sometimes grayish exudation-membranes on conjunctiva, which may be stripped off. Discharge of flakes of lymph. Advanced stage marked by softening of parts, from disappearance of fibrinous matter, and by discharge of pus. Great ten-

junctiva and sub-conj. tissue, forming triangular, vascular prominence, generally at nasal side of eve, with base toward inner canthus, and rounded apex at edge of cornea, ar encroaching more or less upon latter. Called pterygium tenne [Lat. for thin], or crassum [Lat. for thick], according to its thickness. Requires no treatment unless it extends upon cornea so as to obstruct vision. May then be removed by (1) Excision: performed by dissecting growth off from cornea and scierotic to a point near canthus, and maiting conjunctival wound by sutures. (2) Transplantation; performed by dissecting it off up to base, and then inserting it into an incision made in conjunctiva parallel to lower edge of cornea, retaining it there by sutures, Or (3) Ligature; by thread passed around growth at two or more points, and tied, so as to cause strangulation. If preferable, a new pupil may be made by iridectomy opposite clear part of cornea.

XEROPHTHALMIA, or DRVNESS OF THE EVE [Gr. ξημοις, dry, and οφβαλμος, eye]: generally results from severe chronic conjunctivitis. Condition one of atrophy and cicatricial change in cornea, conjunctiva and sub-conjunctival tissue; the surface being of dirty greenish or grayish color, and tendinous appearance; and dry, scaly, and stiff from destruction of secreting apparatus. Obliteration of palpebral folds and more or less ad-

on of lids to globe. Treatment ineffi-. Dryness may be alleviated by bland

, such as milk or glycerine.

MBLEPHARON [Gr. 60v, together, and ραρον eyelid ]. Adhesion between contiva of lids and globe. Results from ins causing excoriation and sloughing, or long-continued inflammation. Adhemay be complete, or only partial, in form nall bands or bridles. Difficult of cure. ous operations are done, aim being to rate surfaces and to keep them from re-

NCHYLOBLEPHARON. [Gr. αγκυλωσις, ming, and βλεφαρον, lid.] Adhesion een edges of lids. Has same causes as depharon, and sometimes associated with

Requires same treatment.

### TUMORS OF CONJUNCTIVA.

nguecula. [Lat. pinguis, fat.] Small, wish tumor, of fatty appearance, situated corneal margin and chiefly seen in old le. Consists of hypertrophied conjuncand epithelium. Harmless. May be ed if desired.

rmoid tumors. Smooth, yellowish tu-, covered with conjunctiva and, perhaps, hairs. Composed of connective tissue fat. Generally congenital. Excision is

er treatment.

Warts, similar to those on prepuce, may occur on any part of conjunctiva. Snipped off with scissors.

SYPHILITIC ULCERS AND CANCER occur rarely (p.153).

### CORNEA.

INJURIES AND WOUNDS: Are of various kinds. The primary treatment in all is to put the eye at rest and allay irritation by soothing applications. Atropine should be applied several times daily and cold compresses, if reaction is severe. Where epithelium is abraded a few drops olive oil useful to lubricate parts and allay pain. Compress bandage may be used to restrain motion of lids and exclude light. Beyond this, treatment must be adapted to special requirements of case.

Foreign bodies: Very frequent occurrence, most common being particles of metal, dust, glass, gunpowder, etc. Cause severe reaction according to depth to which they penetrate and time they are allowed to remain. (Exceptionally foreign body remains for indefinite period, causing no disturbance.) Generally easily seen by simple inspection or oblique illumination. If superficial, may be removed by spud; if firmly embedded, by needle or fine forceps. When there is danger of foreign body falling back into anterior chamber dur-

ing efforts at removal a broad needle is sometimes passed into chamber so as to press upon foreign body from behind, and support it as it is being extracted. While removing foreign body eyeball may be steadied as follows: stand behind patient, with his head against your chest; have him look downwards, and press tip of your forefinger against sclerotic just above cornea, and tip of middle finger of same hand against sclerotic below and a little to inner side of cornea. Or lids may be held apart by speculum and eyeball steadied Ether sometimes reby fixation forceps. quired. In some cases it is found useful to remove a small circular piece of the cornea, including the foreign body, with a trephine.

Injuries from chemical agents, burns, etc.: Apt to cause sloughing and permanent opacities. To be treated as similar injuries of con-

junctiva (p.89).

Abrasion of epithelium: Readily seen as roughened, glistening facet. Very painful. Frequent cause is scratch from finger-nail.

Wounds: Chiefly dangerous from injury to deeper parts, which may fall forward (prolapse) into wound or escape altogether. Contused wounds apt to cause suppuration. Incised wounds generally heal readily.

KERATITIS [Gr. κερας, cornea]: INFLAMMA-TION OF THE CORNEA: Results from injuries, exposure, constitutional disease, mal-nutrition, inflammation of adjacent parts, etc. May

vision, ciliary irritation, zone around corneal margin, pair lachrymation, contraction of junctival congestion. Corne swollen; if ulcerated, it become ruptures, and allows deeper p or escape. If thinned or soften forward from intra-ocular pro staphyloma (p. 109). After rec opacities and alterations of cu main, with corresponding loss treatment of acute corneal infi cardinal rule to avoid all irrit tics, and to pay special attent and general health. Atropine, of eyes are always proper. may be tried if symptoms a When disease does not improplan, or becomes chronic, th ment requires special exper

there is great photophobia an

vessels traversing affected region. Epithelium may be shed, causing superficial ulceration and great pain from exposure of nerves. Under favorable circumstances tends to recovery. May run into one of other forms or

be combined with them.

Phlyctenular keratitis: characterized by phlyctenules in superficial layers of cornea, like those of phlyctenular conjunctivitis; and often associated with latter disease. Phlyctenules appear as inflammatory nodules, singly or in groups on any part of cornea, but most often at margin; may be surmounted by vesicles which burst and leave small ulcers, or ulcers may result from loss of tissue of nodule without formation of vesicles. When eruption is limited, attendant congestion is partial; a triangular network of vessels is seen running towards phlyctenule, its base toward retro-tarsal fold and its apex at phlyctenule, if this is at edge of cornea. If phlyctenule lies some distance from edge of cornea, apex of triangle appears cut off at latter-a space of clear tissue intervening between it and phlyctenule. If disease is severe, vascular keratitis may supervene, vessels extending upon cornea quite up to phlyctenule. Pain and photophobia generally marked; latter symptom often being out of all proportion to amount of inflammation. Secretions from eye irritate and excoriate parts over which they flow. Disease most common

in weak, scrofulous, and badly-nourished children. May arise from irritations of ciliary nerves, either directly or through fifth pair, Seen in conjunction with eruptions of herpes, eczema, etc., in course of trifacial nerve; also with conjunctivitis and nasal catarrh. In treatment, these eruptions and catarrhs should re-

ceive special attention.

Interstitial, parenchymatous or diffuse keratitis: Marked by cell-proliferation in deeper layers of cornea, causing swelling and diffuse cloudiness. Latter usually extends from margin toward centre; rarely the reverse; varies in degree from slight haziness to dense opacity, as of ground glass; usually grayish; may be thicker in some parts than others, causing white or yellowish patches. Surface usually loses its polish, and assumes dull, stippled appearance from loss of epithelium. Vessels may appear in substance of cornea running from margin toward centre. May be so numerous as to cause bright red color, like extravasated blood. Very little tendency to ulceration. Apt to be tedious, but after duration of many months cure may be complete. Has been specially described by Mr. Hutchinson [London] as occurring, together with flat face. notched teeth, coarse, pallid skin, etc., in inherited syphilis,

Suppurative keratitis: In this form inflammatory infiltration becomes changed into pus, which appears as yellow opacity in cor-

neal tissue. Suppuration may be limited, or entire cornea may be changed into yellow, necrosed mass. If suppuration is enclosed by corneal tissue it forms an abscess; if superficial, an ulcer. Sometimes sinks down between layers to lower margin of cornea, presenting appearance called onyx [Gr. ovok, nail], or unguis, [Lat. for nail,] from resemblance to lunula of finger-nail. If pus breaks through into ant. chamber, it forms hypopion, (p. 138). By oblique illumination, and looking at cornea in profile, it is generally easy to distinguish between onyx and hypopion. Sometimes both coexist. Suppurative process may be attended with vascularity and very acute symptoms, or there may be no vessels, and little or no irritation. Latter form specially dangerous from rapid death and sloughing of tissue. Abscesses may be absorbed or burst open, or pus may undergo fatty or chalky degeneration, leaving dense opacity. When abscess opens, an ulcer results. Ulcers also occur superficially without precedent abscess. Are of variable size, shape and depth, and dangerous, according to situation and course. A very dangerous form is the crescentic marginal ulcer, which shows tendency to encircle cornea and cut off nutrition of central parts. In small ulcers, extending to Descemet's membrane, latter may bulge forward through ulcer like a vesicle, forming keratocele or her-

apt to carry mis torward may become firmly adherent of ulcer, forming what is call nechia [Gr. rov, together, and If perforation is large, iris through it, and become adl its edges, leaving staphyloma times after healing of ulcer, of aqueous humor and actic muscles are sufficient to tear sions of iris, and allow it to proper place. Lens may also ward with the iris against the p when it returns to its positio carry with it some inflamma its anterior capsule, forming cataract. Adhesions of iris a surface cornea may be so exte that ant. chamber is never Where sloughing of cornea is

or total, escape of lens and

tive inflammation may result from same causes as other forms. Is a dreaded result of operations involving corneal incision, especially in old and feeble. Bruised and lacerated wounds apt to cause it. One of the dangers of severe conjunctivitis. Occurs in paralysis of fifth pair, as neuro-paralytic ophthalmia. Such paralysis renders cornea anæsthetic, hence insensible to action of external irritants, and seems also to exercise bad influence upon its nutrition.

Treatment includes ordinary remedies for keratitis (p. 100). Special cases call for special Not customary to evacuate pus except in hypopion. Even large hypopion is often reabsorbed. Often essential to keep intra-ocular pressure reduced: done by paracentesis or iridectomy. Paracentesis may be repeated frequently. Hot fomentations are often useful, especially in asthenic form, where there is danger of rapid death of tissue. neuro-paralytic form it is necessary to protect cornea by bandage. In deep ulcers it is better to perform paracentesis through their base than to allow spontaneous perforation. In indolent superficial ulcers Sæmisch's operation sometimes succeeds.

PANNUS [Lat. pannus, a cloth]:—is, strictly speaking, a non-inflammatory, superficial, vascular opacity of cornea—a neoplastic formation left by preceding inflammation. The term, however, is also applied to acute and chronic vascular keratitis, where formation of

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### PANNUS.

new tissue is still in progress. Disease may involve part or whole of cornea. Slight grade is called pannus tenuis, severe one, pannus crassus (p.96). In extreme degrees cornea may have red, fleshy appearance. Disease may continue for months or years without marked change. Complete cure may occur, but is rare. As a rule, opacities are left, and sometimes cornea is completely covered by thick, dry, tendinous membrane. May become thinned and bulge forward. Most frequent cause of pannus is trachoma; and corneal surface may then present granulations like those on lids. May be traumatic frem longcontinued irritation, such as that from foreign bodies, inverted cilia, exposure to atmosphere, etc. Treatment aims, after removing cause, to hasten resolution of opacity. For this, irritant powders and ointments are used if no inflammation exists. Sometimes remedies lose effect and have to be changed or intermitted. As last resort in desperate or includation with blenorrheal matter may be tried. This produces severe purulent may inflammation under which pannus may clear up. Best pus to use is that from ophthalmia neonatorum. A drop of this may be applied to eye, and in a few hours purulent conjunctivitis usually results, which is allowed to run its course unchecked. Inoculation only admissible where whole cornea is involved in high grade of pannus; and greater the vascu

### CORNEAL OPACITIES.

larity, better the chances of success. Ulcers contra-indicate operation. Where fellow-eye is sound, it must be hermetically closed. Inverterate cases sometimes treated by operation of Syndectomy, which consists in removing a strip of conjunctiva and sub-conj. tissue all around edge of cornea so as to cut off blood

supply from latter.

OPACITIES are frequent result of corneal inflammations with cicatricial deposit. Practically, divided into superficial and deep; former affecting epithelial layer, latter the parenchyma. Faint, superficial opacity called nebula [ Lat. for fog ]. Thick dense one, leucoma, [Gr. Aevkos, white]. Cicatrix, combined with prolapse and adhesion of iris, is called leucoma adherens. White chalky-looking incrustations may result from metallic deposit, as where lead-lotion has been applied to an ulcerated cornea (p. 60). Opacities impair vision according to situation and according to alteration of curvature accompanying them. May necessitate constant straining for vision of small objects, leading to myopia and strabismus. If they prevent distinct retinal impressions, eye may become amblyopic from disuse and deviate outward (p.149). In children, may cause nystagmus. Many opacities disappear spontaneously, especially in young, healthy subjects. As a rule, the more recent and superficial the opacity, the better the chance of

filled up with transparent opacities resist all treatme vision one of the operations f may be performed. New made opposite part of corr transparent and of most co Where small part of clear over pupil, vision may often stenopæic spectacles [Gr. orev oπη, hole which cut off lateral light. They are made of m glass plates with small cent They contract visual field gre be used for close work. opacities which cannot be rea times tattooed with India effect. Operation is done wit

needles bound together on points project evenly: thick p is spread over opacity and pr perficial layers by needles.

CICATRICIAL STAPHYLOMA [Gr. σταφυλη, bunch of grapes :- generally the result of ulceration. Floor of corneal ulcer very apt to yield and bulge forward from intra-ocular pressure. During healing-process, bulging part is covered over with cicatricial tissue, and bluish-white protrusion, or staphyloma, is left. To this, iris may be partially adherent poste-Or, if perforation occurs, iris may prolapse, close the wound, protrude through it, and form basis for the cicatricial deposit. Staphyloma may be partial or total, involving whole cornea. If partial, tendency is to increase. Lens may retain its position, or fall forward and press against post, surface of protrusion. Walls of staphyloma may be very thin and may burst; or may gradually thicken from fresh inflammatory deposit. Re peated attacks of inflammation and ciliary iritation may occur and lead finally to sympathetic trouble, especially where iris is involved and in state of constant tension. Staphyloma sometimes results from wounds of cornea and from cataract-incisions. In partial staphyloma, treatment aims to prevent further progress, to reduce protrusion already existing, and to improve vision. Repeated paracentesis, with methodical use of pressure bandage. or iridectomy followed by pressure, may succeed. In very extensive or total staphyloma, splitting or excision may be performed -lens being also removed. Splitting is done

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by passing knife through long diamete tumor and allowing edges to fall togethe unite, with view to producing flatter cica Excision performed by cutting tumor ( its base and allowing edges of wound to lapse and cicatrize. Critchett's oper [Critchett, London, 19th Cent.] consis passing several curved needles armed silk through base of tumor and cutting off just in front of them. Needles are drawn through and sutures tied so as to edges of wound and form flat stump for ficial eye. Operation dangerous from ri sympathetic ophthalmia if needles go the ciliary region. Enucleation often prefer always indicated where there is so a ciliary irritation as to endanger fellow-e

CONICAL CORNEA: KERATO-CONUS: cone-shaped staphylomatous protrusio cornea whose cause is not well unders Cornea is thinned and less resistant, but ocular pressure is generally not increase is sometimes below normal. Affection c on as a rule very slowly, and without priritation: may remain slight or advan high degree, in which apex becomes extrapt thin and is apt to be clouded—but it bursts, except from violence. First thin ticed by patient is impairment of visic eye becomes myopic from lengthening of and astigmatic from irregular curvatu cornea. In high grades, astigmatism

great distortion of images and reduplication of them. Slight grades often overlooked; high degrees may be easily seen, especially in profile. If eye is illuminated by ophthalmoscope, a central red reflex is seen surrounded by a dark ring, outside of which is a second bright red ring. By throwing light from different angles, side of cone opposite light is seen in shadow. If fundus is examined, everything appears distorted. Treatment unsatisfactory. Little improvement of vision from glasses. Stenopæic slit occasionally of use. straining of eyes must be avoided. Operative treatment comprises iridectomy, iridodesis, trephining, and Graefe's operation, which consists in removing superficial flap from apex of cone and cauterizing part a few times with nitrate silver, so as to produce a shrinking cicatrix, and so flatten protrusion.

KERATO-GLOBUS: HYDROPHTHALMIA: BUPHTHALMOS [Gr. βους, an οχ, and οφθαλμος, eye]: Is uniform spherical bulging of entire cornea and neighboring part of sclerotic, generally associated with increased size of anterior chamber and tremulous iris and lens. Condition generally congenital; may appear after inflammation. Cornea may remain transparent or become cloudy, especially at margin. Causes great impairment of vision, changes in deeper tissues and often ultimate blindness. Treatment of little use. Iridectomy seems to

do most good.

away and eye is kept it...
comprises atropine; touching fistula
trate silver; bruising its edges with
ceps to excite healing; compress b
iridectomy, etc. (See p. 246.)

## SCLEROTIC.

EPISCLERITIS appears as a dusky ing on sclerotic near edge of corne on temporal side. Simulates phlyc shows no tendency to ulcerate or May be dull pain with ciliary irritenderness. Disease obstinate. for syphilis and rheumatism, and pilocarpine locally, are most useff STAPHYLOMA of sclerotic gene from inflammations which weak that it yields before intra-ocular properties.

### DISEASES OF IRIS.

be necessary to remove eye. Post, staphyloma generally occurs in myopic eyes (p. 121).

WOUNDS of sclerotic dangerous, according as they implicate neighboring tissues and allow contents of eye to escape. Small wounds may heal readily. Cleanly cut wounds may be united by fine suture, any protruding choroid or vitreous being cut off by scissors.

### IRIS.

SIMPLE WOUNDS may heal readily or set up iritis. A severe blow upon eye sometimes causes iris to rupture at its circumference,—coredialysis [Gr. κορη, pupil, and διαλυσικ, rupture], or irido-dialysis, forming a secondary pupil, which usually remains permanent.

FOREIGN BODIES: Best way of removing one is by excising portion of iris in which it lies.

PROLAPSE OF IRIS is frequent result of perforating wounds of cornea (p. 104). If prolapsed tissue cannot be replaced it may be cut off, or treated by repeated puncture with needle, followed by compress bandage, in hope of keeping tumor collapsed and allowing edges of wound to heal over it. Atropine should be frequently applied. (See p. 67.)

IRITIS; INFLAMMATION OF THE IRIS: Caused by injuries, cold, syphilis, gonorrhæa, rheumatism, extension of inflammation from other parts, etc. Conjunctiva is suffused, and



phia and lachrymation not always severe. always impaired. From close connecbetween iris, choroid, and ciliary body, mmation readily extends from former to r and vice versa. If, during iritis, ciliary becomes involved (irido-cyclitis) there is tenderness over ciliary region-a sympnot present in simple iritis. If choroid mes involved (irido-choroiditis) sympare all more serious ; vitreous is clouded, there is loss of vision and contraction of not explained by iritis alone. This conn is most common in eyes which have red several attacks of iritis, leaving beextensive synechiæ. Where cornea and tre both inflamed, disease is called kerato-If synechiæ are left after iritis, iris is eded in movements and constantly dragged by adhesions; free communication beant, and post, chambers is interrupted, natural balance of pressure destroyed. condition tends to keep up chronic irrin and to cause frequent relapses, which finally destroy eye. (p. 247.)

continent.—Perfect rest of eye and procon from light. Chief remedy is atropine, keeps pupil dilated and away from lens at adhesions cannot form; puts inflamed at rest by paralyzing its muscles; con-

blood-vessels and lessens tension. Its is resisted in inflammation and a strong a should be used (2 to 6 grs. to ounce).

Enterna. E. C. Paper the state of Puping Co. Puping Co Section of the Control of the Contro minusco a control for sor Assistant bus surported.

Come them to be surported.

The top be sure to be surported and brown in the surported in the surpo tre hat boo be writtened and bro.
When there is see not too form. When there is the offered to enter the offered to the offered t seed to start a concention, and may be resident the patient has seem sees if beneficial. Sometime countries for after the Sometime patient has a some of mercun seed by the source of mercun seed by the seed of the s in the second of patient is great tendency be brought by in. January be brought such cases, however, constitutional treatment.

In severe and Sometiment of the server and the ser as a severe and advisable in relaps-Roistures because in.

# DISEASES OF IRIS.

rease of fluids causes pupil to dilate?]: D TATION OF THE PUPIL.—Chief causes are reased tension, paralysis of third nerve, in tation of sympathetic, disease of optic nerv and brain, action of certain drugs, such as hy Oscyamus, belladonna and stramonium. My driasis generally confined to one eye, and may be uniform or partial. When not caused by drugs, pupil not dilated to maximum and has sluggish action.

MYOSIS [Gr. μυω, to close.]: CONTRACTION OF THE PUPIL.—Caused by irritation of branch of third nerve supplying sphincter of pupil, by paralysis of sympathetic filaments to dilatator of pupil (such as occurs in spinal lesions), by constant work at minute objects (as in watchmaking,) by certain drugs, such as calabar bean, opium, etc. Treatment of mydriasis and myosis depends on cause.

HIPPUS [Gr. iππος, horse?]: is chronic spasm of iris causing rapid, alternating contraction and dilatation of pupil, independent of stimulus of light. Generally associated with

IRIDODONESIS OF TREMULOUS IRIS is, and δονεω, to tremble.]:—is marked by embling of iris when eye is moved about. used by loss of support of crystalline lens

YSTS OF IRIS—rare, and generally result ome injury. Appear as transparent vesion surface of iris, attached by becleft iris: corectopia [Gr. κορη, pi πος, out of place], or eccentric po pil: and polycoria [Gr. πολυς, mai pupil], or multiple pupil. (p. 247

### CHOROID.

RUPTURE OF THE CHOROID from blows upon eye, with or wit tion of other tunics. Accide followed by hemorrhage and i with corresponding impairmen Blood may be confined to chor itself, or penetrate between it or retina, or into vitreous humo hemorrhages seen with ophthalm

such means as cold dressings, compress band-

age, and leeches to temple.

CHOROIDITIS: INFLAMMATION OF CHO-ROID :- Rarely independent, but usually associated with inflammation of iris, ciliary body

or retina.

Disseminated or exudative Choroiditis :marked by circumscribed, yellowish spots of exudation on surface and in stroma of choroid. Retinal vessels may be seen running uninterruptedly over them, and intervening tissue appear healthy. Exudations often appear first at periphery of fundus, and advance towards centre. May increase in size and coalesce, forming larger patches. Vitreous often contains opacities, and retina may suffer atrophy from pressure of exudation. When exudations are absorbed, corresponding portions of choroid become atrophied, allowing sclerotic to shine through and forming glistening white spots. Borders of these spots are black from collections of pigment, and bloodvessels are often seen running across them. Vision is impaired, and field contracted and interrupted by scotomata. Disease often due to syphilis. Treatment: Rest of eyes, and protection from light by blue glasses. In both syphilitic and simple forms mercury and iodide of potash are beneficial, combined with tonics, if necessary. Eyes may be leeched occasionally, if patient is not anæmic.

Suppurative Choroiditis. Panot1"

pneumonia, puerperar lever, presente la a most acute and violent suppur flammation involving whole eye. conjunctiva swollen, red and dedemannea cloudy; aqueous turbid; iris puward; pupil dilated or blocked wit vitreous, retina and uveal tract with pus; tension increased and gipainful and tender. Disease as a in total destruction of eye and at globe. Treatment: Cold and leeche atropine; canthotomy to relieve prilids; paracentesis to relieve tension

exit to pus. Poultice sometimes to cand hasten suppuration.

A serous form of choroiditis some curs in connection with serous irititoms of inflammation may be very vitreous and aqueous are cloudy, fundus and impairing vision. Tens but may increase to such an extent the

posterior; posterior staphyloma: Elongation of post, half of eye with stretching, inflammation and atrophy of choroid and retina. Precise etiology disputed. Occurs commonly in highly myopic eyes, leading to still further increase of myopia. Occurs rarely in hypermetropia. Predisposition seems to be congenital. and exciting causes to be strong efforts of accommodation and convergence for near vision, and continued hyperæmia of posterior scleral zone. May be stationary or progressive. In former case, ophthalmoscope shows more or less regularly-shaped crescent at outer edge of optic disc (or a zone extending nearly or quite around disc) of glistening white color, from sclerotic shining through the atrophied choroid, and with edges well defined, and fringed with pigment; retinal vessels are seen running over it; myopia does not increase, and eye is not painful or irritable. But if affection is progressive, inflammatory symptoms are added: edges of crescent are congested and blurred; additional white patches appear about it and unite with original one; vitreous becomes turbid; myopia increases; eve is irritable and vision impaired. Glaucoma, detachment of retina, or choroidal hemorrhages may supervene. Sometimes crescentic atrophy of choroid occurs without any staphyloma of sclerotic. Treatment: In active form, complete rest of eyes; blue glasses; avoidance of all causes of congestion:



### CILIARY BODY.

CYCLITIS. [Gr. KUKNOS, circle.] INFLAMMA-TION OF CILIARY BODY: Generally arises in connection with iritis and choroiditis, but may also come from injury. Diagnostic symptom is pain over ciliary region, especially when this is pressed upon. Also, zone of ciliary injection around cornea; photophobia and lachrymation; enlargement of veins of iris; increase of tension; turbidity of aqueous and vitreous: loss of accommodation and impair ment of vision. Exudation may be serous, plastic or purulent. Traumatic cyclitis, caused by wounds in ciliary region, foreign body in eye, dislocated lens, &c. May result in fatal suppuration and atrophy of globe in spite of every precaution, and may also cause sympathetic inflammation of other eye. Leeches. hot or cold applications, and atropine, may be tried, but if disease progresses unfavorably removal of eye is advisable, to ensure safety of other one. Cyclitis occurring in course of iritis or choroiditis requires same treatment as those affections, and may recover perfectly.

### RETINA.

HYPERÆMIA is caused by prolonged exposure to bright light; by fine work, espe-

ally pulsate. Eye is irritable, e. and dreads light. Indications a cause, put eye at rest, and prot glasses. Leeches and cold do useful.

Passive venous congestion occ obstruction to outflow of venous appear large, dark, tortuous, an

Hyperæsthesia of the When not dependent on inflation most commonly caused by strain fine work, by exposure to light, etc. The patient is unal eyes, owing to dazzling sensations morbid persistence of retinal lachrymation, spasm of orbiculary neuralgia. Very rarely, with toms there is nyctalopia [Gr. 10 10445, vision], or the power of reavery faint light. Otherwise,

perceptible organic change. Most common causes are prolonged exposure to intense light, lightning-stroke, concussion of eye or head, disuse of eye (as in squint), neuralgia of fifth nerve, and old age. Distinctness of vision is impaired, especially in feeble light—hemeralopia [Gr. ἡμερα, day, and οψες, vision]. Treatment must depend on cause. Perfect cure often results. In anæsthesia from disuse, systematic exercise in reading with affected

eve is often beneficial.

RETINITIS; INFLAMMATION OF RETINA: Caused by severe exposure to bright light or fine work; syphilis; Bright's disease; extension of inflammation from other tissues; embolism of central artery; injury, etc. Usually associated with inflammation of optic nerve (neuro-retinitis). May also be combined with inflammation of choroid and vitreous. Generally affects connective tissue primarily, and extends later, if at all, to nerve elements. Inflammatory product infiltrates tissue, and appears as exudation upon surface, being evenly spread over it, or collected into irregular patches. Retina swollen and ædematous. Tissue and vessels may undergo sclerosis, fatty degeneration and atrophy. Extravasations of blood often occur; most common in inner layers, but may extend to choroid or into vitreous; may be absorbed or changed into opaque, degenerated mass; when very extensive, condition is called retinitis apoplectica. [Retinal

apoplexy may also occur without inflammation, from injury or atheroma of vessels]. In retinitis of Bright's disease (retinitis albuminurica or nephritica) there is large amount of exudation, which soon becomes fatty, in region of papilla, and also numbers of white, glistening, stelliform spots scattered about; and hemorrhages are numerous. In retinitis, in course of syphilis, there may be numerous white, punctiform opacities, especially in region of macula, and hemorrhages are not likely to occur. In retinitis of leucocythæmia (retinitis leucamica) there are round, yellowishwhite patches, sometimes with red borders, strewn about periphery of retina, and near macula-formed from masses of exuded white and red blood-corpuscles; fundus has pale vellow tint, and arteries look pale and blood-Suppuration of retina scarcely ever occurs except in panophthalmitis.

Ophthalmoscopic appearances of retinitis are:
Opacity of retina, varying in degree from
that of fine mist or film to that of dense, white
patch of exudation. Vessels are obscured
the more the opacity lies in inner layers.
Disc looks blurred, especially its edges. Arteries usually of normal calibre, but veins distended and tortuous. Blood-extravasations
appear as irregular, red patches; if in inner
layers, among nerve-fibres, they are striated,
and have feathery edges; if in outer layers,
they appear more smooth and uniform. Ex-

ternally appearances of eye usually normal. Vision impaired according to severity of inflammation, and extent to which nerve-elements suffer. Sometimes it remains normal, when ophthalmoscopic appearances are very marked. A very common complaint is that everything is seen through a mist or haze. Pain generally slight. Disease may run acute or chronic course, and end in recovery or in incurable atrophy and blindness.

Treatment: Complete rest of eyes. Blue glasses. Special attention to general health. Leeches to temple in acute stages. Small

doses of mercury sometimes act well.

Retinitis pigmentosa; Pigmentary degeneration of retina :- Generally hereditary and associated with other bodily defects. Begins in early childhood, and runs very slow course, usually affecting both eyes. Often combined with post. polar cataract. Characteristic ophthalmoscopic appearance is a peculiar deposit of pigment scattered over retina, appearing as irregular, stellate, black spots, with branching processes (something like bonecorpuscles in form), and as small black lines, showing tendency to follow course of vessels. Retina and disc atrophied and vessels small. Choroid also atrophied in some cases. There is gradual contraction of visual field and increasing torpidity of retina. About the first symptom noticed is hemeralopia (p. 125). No treatment of any service.

### 125 EMBINISM OF CENTRAL ARTERY.

DETACHMENT OF RETINA: Caused by effix in N inflammatory material, blood, etc., between choroid and retina; by loss of its secret from diminution in bulk of vitreous; ty elementation of eye, as in myopia; by tuman beneath it; by concussion from blows er eve, etc. May be partial or complete, With antical moscope an ordinary partial deturnent appears as a tremulous, bluish-gray sur projecting into vitreous, with retinal vessels bending over it, and surrounded by red choro.dal reflex. Very small detachments may appear as fine gray streaks. In total detarament no redex can be obtained from ferries at all. Symptoms complained of are matting cloud before eye, metamorphopsia, and loss of vision in part of field corresponding to detachment. Thus if lower half of retina is detached, upper half of field will be absent. &c. Prognosis unfavorable. Tendency of detachment is to increase. Only exceptionally it ruptures, or subjacent fluid is absorbed and retina falls back into place and some degree of sight is restored. Treatment chiefly expectant. Success has been reported from keeping patient for long time on his back, and also from operation of passing needle in through sclera and opening sac so as to allow fluid to escape and retina to fall back into place.

EMBOLISM OF CENTRAL ARTERY of RE-

or irritation. Optic disc appears blanched, and retinal vessels reduced in size and more or less bloodless. Arteries may appear as small white threads; veins small and irregularly filled. Soon retina becomes opaque, except at fovea, which appears as cherry-red spot from choroidal reflex. Condition ends in atrophy of nerve and retina, and is irremediable.

EPILEPSY OF THE RETINA:—Is characterized by sudden dimness of vision, advancing from the periphery of the field toward the centre, until total blindness results, which lasts generally but a few minutes, and then completely disappears. The attacks occur at variable intervals, and affect one or both eyes. Condition is supposed to be due to spasm of

retinal vessels. Affection is rare.

Tumors of Retina: Glioma [Gr. ylia, glue]: is composed of round, spindle-shaped, and branching cells, with granular, intercellular substance, and originates in retinal connective tissue. Occurs almost exclusively in young children, and often unnoticed until far advanced. Appears as bright, yellowish tumor, projecting into vitreous. Surface vascular, and retina in vicinity detached. Eye may look normal externally and be painless, but vision is lost. As tumor grows, it fills globe, presses forward iris and lens, bursts through cornea, and presents externally fungous, bleeding surface—occasioning great

### CRYSTALLINE LEN

CATARACT: Is an opacity of c caused by interference with its n thus result from senile involuti ting disease, such as diabetes; especially of uveal tract, which supply or extends to lens itselfchakos, lens); or from injury. been observed as cause, but pr action not understood. In ma cataract occurs after 45. any age, and is sometimes cong forms described, but great pra is into (1.) Soft or cortical catar below middle age, and of so throughout. (2.) Hard or nu rring after middle age

of fatty or chalky consistence; or fluid parts may increase so that capsule is filled with milky liquid. A cataract with fluid cortex and hard nucleus is sometimes called a Morgagnian cataract. Traumatic cataract is soft cataract following injury and developing usually with special rapidity. Most frequent causes are wounds which perforate capsule and allow aqueous humor to reach lens-substance, which becomes soft and opaque, and may swell to such an extent as to press upon neighboring parts and excite dangerous inflammation. In more favorable cases it may be wholly or partially absorbed. Traumatic cata ract may also result from simple concussion, without any rupture of capsule. Partial cortical cataracts may occur and are often called capsular cataracts. They are usually not due to changes in capsule, but to changes in cortex near its inner surface. After iritis or perforating ulcer of cornea a deposit of lymph is often left on ant. capsule of lens (p. 104); superficial lens-matter just beneath may also suffer in its nutrition and become opaque, while intervening capsule remains transparent. This is called ant. central capsular cataract. If it projects much above capsule it is called pyramidal cataract. An opacity of cortical substance lying upon post. capsule, or a deposit of lymph upon latter from vitreous, is called post. polar cataract, and is much less frequent. Sometimes a single layer of lens-

fibres becomes opaque, while remainder retain their transparency. This form is called inminated, lamellar, or sonular cataract, and is most common during infancy and youth. It may remain stationary or become complete. Nuclear, hard, or senile cataract is distinguished by a hard, central portion or nucleus, surrounded by a less dense layer of cortical substance. As cataract progresses, distinction between cortex and nucleus becomes more and more evident, latter appearing as round central patch of greater or less size and of vellowish color. Progress usually slow, year often elapsing before cataract matures. Re tregressive changes may occur, as in soft form Soft cortex may undergo absorption or fatt and chalky degeneration, while nucleus be comes harder. Capsule is then apt to becom tough and adherent. The name black catar and has been applied to a very rare form where the color of the lens is very dark.

Symptoms: A fully formed cataract easily seen, as pupil is filled by grayis opacity. Incipient or partial cataracts mabe seen by oblique illumination or ophthamoscope. If latter is used, mirror only employed, when, on illuminating eye, an cataractous opacities appear as black spoagainst red background. To ensure thoroughness, pupil should be dilated by atroping Complete soft cataracts, when seen by obliquillumination, present bluish-gray opacities.

slightly denser at centre than at margin. In hard cataracts opacity presents yellow nucleus surrounded by grayish cortex. In pure lamellar cataract, opacity is uniform and sharply marked off from transparent border and overlying strata of lens. With ophthalmoscope, opacity appears as dark disc, and light shines through it from fundus. Vision impaired just according to degree of opacity. When cataract is congenital, or has developed in childhood, the lack of vision may cause loss of functional power of retina, or muscular derangements, such as strabismus and nystagmus (p.146). In cataracts appearing after puberty these effects seldom seen.

Treatment: Medicine accomplishes nothing except in way of improving general health, and so impeding progress of opacity. While cataract is maturing, vision may be temporarily improved by dilating pupil, by shading eye from light or by atropine. In partial cataracts which have become stationary, operation for artificial pupil may be performed to expose clear portion of lens. Complete cataract may be removed by one of several operations (p. 74). If degenerative changes have occurred, removal of lens is more difficult. Before operation, vision and field should be tested; for, if function of retina has been lost, operation is useless and unjustifiable. Progress of cataract may be hastened by opening capsule with needle, so that aqueous humor may act upon lens. In traumatic cataract from rupture of capsule, eye should be treated with atropine and bandage, just as if a needle operation had been performed. If lens-matter swells excessively, it should be evacuated at once through corneal incision. Chief bad results from extraction of cataract are suppuration of cornea, iritis, irido choroiditis, prolapse of iris, and imperfect union of corneal wound. After lens has been removed, cornea is only refracting surface left, and strong convex glasses are needed to give acute vision, except in rare cases where eye was very highly myopic before operation. As accommodation is lost, spectacles give acute vision only at one distance, and more than one pair is thus needed. Where lens has been removed from only one eye, and other is normal, spectacles cannot be used, because of very different refraction of eyes. Still, eyes adapt themselves to new conditions, and work fairly together.

Secondary Cataract: Is name applied to opacities which appear in area of pupil after lens has been removed. [Also applied to cataract following another disease of eye.] Opacities may be in capsule or due to lymph-deposit from iritis; or to particles of lens matter left behind by operation. Capsule may cause impairment of vision by becoming wrinkled, without being opaque. Operations for such secondary cataract consist in tearing



#### DISLOCATION OF LENS.

ole in them by needles passed through nea, etc. (See p. 77). If there is much ph in pupil, iridectomy may be necessary. ISLOCATION OF LENS; ECTOPIA LENTIS εκ, from, and τοπος, place]: Generally Its from injury, but may be spontaneous weakening of suspensory ligament. May omplete or partial. In latter form, lens be moved to one side, so that its margin ses area of pupil, or it may be merely rod on its axis. Iris tremulous, where supof lens is lost. Vision greatly disturbed. ficial pupil may be made in more favorable e, or lens may be extracted, especially causes irritation. In total dislocation: ens may lie in ant. chamber. (2) In vius. Is then apt to act as foreign body, may cause sympathetic trouble. (3) ler conjunctiva. This only occurs where y blow has ruptured sclerotic, leaving unctiva intact. In all cases of total distion, lens should be removed at once if ible.

enticonus or Conical Lens has been erved.

#### VITREOUS HUMOR.

DREIGN BODIES lodged in vitreous usually te dangerous inflammation and may cause sympathetic disease. Very rarely they be come encapsulated and remain harmless for a long time. Removal may be attempted but is difficult. (See p. 247.)

HEMORRHAGE INTO VITREOUS is caused by rupture of vessels from injury or disease Blood generally comes from choroid, and retina is detached and ruptured. Sudden obscuration of sight results. Small hemorrhage may be seen with ophthalmoscope as dark reddish masses, against red background. It very extensive one renders vitreous so opaquithat no reflex can be obtained from fundus Blood may be slowly absorbed, leaving only few dark floating opacities, and good visio be restored; or eye may be destroyed.

OPACITIES OF VITREOUS, result from in flammation or hemorrhage, and cause annot ing disturbance of vision, appearing as blac spots floating before eye. Are of variou shapes-dark dots, threads, membranes, etc If eye is illuminated from a distance of 12" b ophthalmoscope and then moved quickly i various directions, opacities are easily see floating about behind lens. Sometimes opacit is diffuse, making fundus appear hazy an indistinct. Treatment must be directed t primary disease. Musca volitantes [La musca, a fly, and volito, to fly about], My desopia, are floating opacities often con plained of, not of serious nature, and occuring in perfectly normal eyes. They appe

usually as bright beads floating through field when patient regards a bright clear surface—such as a white wall, sheet of paper, etc. They are due to the vitreous cells, and cannot be seen by ophthalmoscope—which distinguishes them from pathological opacities. Only treatment is to quiet patient's fears concerning them and correct general health.

HYALITIS: INFLAMMATION OF HYALOID OR VITREOUS BODY; -is, usually, secondary to inflammation of surrounding tissues. changes are cell-proliferation, fatty degeneration, connective-tissue formation or suppuration, and become evident by opacity they cause. Inflammation may be partial or com-New formation may be reabsorbed or remain permanently. Vitreous may degenerate and become fluid. This state is called synchisis [Gr. ouv, together, and yvois, flowing, and may be diagnosticated, if there are opacities, by the rapidity and freedom of their movements. If cholesterine is present it appears as sparkling crystals, and condition is called synchisis scintillans [ Lat. scintilla, a spark ]. Fluid vitreous is generally followed by shrinking and atrophy, with falling forward of retina, &c. A soft vitreous does not cause a soft globe, if tension is increased. Treatment of hyalitis is that required for primary affection.

CYSTICERCI have been found in vitreous, generally projecting from the deeper tissues.

PERSISTENT HYALOID ARTERY has been observed as a dark, withered thread running

part or all of the way between optic disc and

post, pole of lens.

#### ANTERIOR CHAMBER.

HYPOPION [Gr. ὑπο, under, and πυος, pus.]; is a collection of pus or lymph at bottom of ant. chamber. Effusion may come from cornea, iris or ciliary body. May be reabsorbed, or, if not too tenacious, may be evacuated by incision at lower edge of cornea (see p. 72.)

HYPÆMIA [Gr. υπο, under, and διμα, blood is an infusion of blood into ant. chamber, and may result from wound of anterior part of eye, or from simple blow without rupture of coats; or, very rarely, it may be spontaneous. Best remedy is compress bandage to keep eye quiet and hasten absorption.

FOREIGN BODIES sometimes lodge in ant. They should always be removed, chamber. if possible, through incision in cornea. p.247.

### OPTIC NERVE.

OPTIC NEURITIS: INFLAMMATION OF THE OPTIC NERVE: - Usually caused by extension of inflammation from another part or from pressure upon nerve and obstruction to its circulation. Occurs in connection with abscess, periostitis and tumors of orbit, basilar meningitis, tumors of brain, collection of fluid between sheaths of nerve, etc. called ascending or descending, according as it originates in eye and extends upward along nerve, or vice versa. Ophthalmoscopic appearances are due to hyperæmia, exudation and swelling. In marked case, disc looks red, opaque and prominent, with margins very indistinct, giving it a woolly appearance. Vessels are seen dipping into swollen mass and partly obscured by it. Veins distended tortuous and pulsating. This condition is called engorged papilla, stauungs papilla, [Ger. stauen, to dam], or choked disc. Vision impaired—but often less so than appearance of disc would indicate. Process usually ends in atrophy of nerve and permanent loss of sight. Neuritis generally associated with retinitis as neuro-retinitis. Treatment varies with cause, and this is sometimes beyond reach of any remedies. Rest, and blue glasses are always proper. Leeches, mercury, iodide and bromide of potash are of service in some cases.

ATROPHY OF OPTIC NERVE results from inflammation, and from other disturbances of innervation and nutrition, some of which are but little understood. Seen with diseases of brain and spinal cord; diseases of orbit;



### 140 ATROPHY OF OPTIC NERVE.

pressure on nerve; blood-poisoning; anæmia, etc. Disc looks flat, opaque, and of glistening white (white atrophy), or bluishgray color (gray atrophy), with its capillaries obliterated; may present a shallow excavation with sloping edges, over which vessels run without any abrupt curve. Retinal vessels may be small-arteries appearing as fine threads. In some cases, however, veins remain large and tortuous, as in inflammation. Vision impaired; field contracted and interrupted by scotomata; color perception impaired. In exceptional cases, disc presents appearance of advanced atrophy and vision remains perfect or nearly so. Treatment adapted to cause and to general condition of patient. Marked benefit sometimes obtained from subcutaneous injections of strychnia beginning with gr. 10, and gradually increasing dose until poisonous effect appears.

TUMORS OF OPTIC NERVE have been ob-

served, but are very rare.

OPAQUE OPTIC NERVE FIBRES: Appear when medullary sheaths are retained for a certain distance, instead of being lost at lamina cribrosa as they normally are. Most common form under which they appear is as an irregular, white, striated opacity with feathery edges, projecting from margin of disc for a short distance into retina. Retinal vessels may or may not be hidden by it. Disc and all

other parts of fundus look natural, and vision is not impaired except by a slight enlargement of normal blind-spot. These facts serve to distinguish opaque fibres near disc from an exudation in that region.

#### AMAUROSIS.

AMAUROSIS [Gr. auavpow, to render obscure,] and AMBLYOPIA [Gr. aushus, dull, and wy, evel:-are names which were formerly much used to denote the various conditions of blindness, before the diagnosis of ocular disease was as exact as it now is. As they convey no definite idea of the nature of the disease, they are objectionable wherever a more exact term can be used. The term amblyopia is still found convenient to designate certain conditions of impaired vision where no organic changes can be seen to account for them. Vision is often thus defective where eye has been long disused, as in strabismus-amblyopia from disuse, or ex anopsia [Gr. ava, without, and owis, vision : in anæmia from severe illness or hemorrhage—anæmic amblyopia; in alcoholism-amblyopia potatorum [ Lat. potator, drinker; in uramia; lead-poisoning; from excessive use of tobacco; from exposure to prolonged glare, as in snow-blindness, and hemeralopia; from irritations of fifth nerve.

as in neuralgia, etc. Treatment consists primarily in removing any supposed local or general cause. Hypodermic injections of strychnia (p. 140) often of service. In some cases vision is restored; in others it deteriorates, and atrophy of nerves becomes apparent.

#### GLAUCOMA.

GLAUCOMA [Gr. Thaukos, green: from greenish reflex sometimes seen in disease.] ARTHRITIC OPHTHALMIA .- A very dangerous disease of eye occurring usually aftermiddle age, and which, if unchecked, ends in incurable blindness. Essential feature is increase of intra-ocular fluids, causing distention of tunics and destructive pressure upon them. Exact etiology not decided: supposed by some to be due to inflammation, by others to perversion of nerve influence governing secretion. Rigidity of sclerotic, interfering with perfect balance of blood-supply seems to play important part. Large percentage of cases occur in hypermetropic eyes. Disease generally attacks one eye first and other subsequently. Generally, premonitory stage of varying duration, and more or less marked by following symptoms: rapid increase of presbyopia, intermittent obscurations of sight; appearance of colored rings around a light; contraction of visual field, most on nasal side; slight

increase of tension; ciliary neuralgia. Acute inflammatory glaucoma presents all symptoms of severe internal inflammation. There is ciliary and conjunctival congestion: photophobia; lachrymation; aching pain in globe and over head, with perhaps fever and vomiting; cornea cloudy; iris pressed forward and ant. chamber shallow; pupil dilated and perhaps presenting greenish reflex; aqueous and vitreous turbid; tension increased, even to stony hardness. Vision much impaired. If fundus can be seen, arteries are found to pulsate spontaneously or from slight pressure on globe, veins are dilated, tortuous and pulsating; and small hemorrhages may appear in retina. If tension has existed long enough, optic disc is found cupped in characteristic manner: excavation extends to margin of disc and its edges are abrupt, steep, and sometimes undermined; nerve is of bluish-gray color, increasing in intensity towards periphery: retinal vessels appear distorted or interrupted where they pass over edge of cup: if object-lens (examining by indirect method) is moved sideways, a parallax is obtained, margin of excavation appearing to move over its centre "like a frame over a picture." Severity and course of disease very variable. May be very rapid, destroying sight in a few hours-glaucoma fulminans [ Lat. fulmen, lightning]; or, acute symptoms may subside, results as acute, but in very insidential symptoms being increased of vision. Affection may progress for a time, and sudden acute attack then supervene. Believ that use of atropine in chronic g precipitate acute attack.

Secondary glaucoma is nam glaucoma ensuing upon one of injuries or inflammations of eye,

Treatment: Great remedy for iridectomy—first applied by vor 1856. It acts beneficially by perducing ocular tension, and if pearly stage of disease, may be disease advances prospects of

### SYMPATHETIC OPHTHALMIA.

be; inflammations involving ciliary body. en most commonly in young. Period of ocrrence variable: may appear shortly after ury or not until many years have elapsedured eye having perhaps meanwhile rophied to a shrivelled stump. Danger of cannot be considered as past so long as inred eye remains, especially if this shows any nderness or irritation. Disease may come very insidiously, and is often unnoticed itil beyond hope of aid. There is a condiin called sympathetic irritation quite differt to sympathetic ophthalmia-regarded by any as premonitory stage of it. In this ndition, eye is irritable and perhaps slightly ected; there is photophobia, lachrymation d neuralgic pain; power of accommodation diminished, and eye is quickly fatigued by e work. These symptoms may recur reatedly and pass off leaving no organic anges, and they cease completely after other e is removed. Sympathetic inflammation atcks iris, ciliary body, choroid, retina, and reous-extent to which these different uctures are involved varying in different Tendency is toward rapid plastic usion, which glues different tissues together d destroys them. Iris is bound to lens and comes degenerated and rotten; it may be awn backward by the adhesions or bulged rward by exudation behind it. Masses of nph may fill pupil or be seen floating in

vitreous. There is ciliary congestion, photophobia, lachrymation, with rapid loss of sight. Pain may be severe or absent, but there is almost always tenderness of ciliary region. Tension increased at first, but reduced later, as eve degenerates. Treatment must be mainly preventive, as little can be done when disease is once established. A blind eye from which there is slightest risk of sympathetic ophthalmia is always better removed, especially if patient lives some distance from medical aid. If injured eye possesses some sight, it may be left, but should be closely watched, and enucleated the moment it sets up sympathetic irritation. If disease is established, offending eye should be at once removed, but chances of benefit are then small. Complete rest of eye and protection from light, strong sol. atropine frequently applied, tonics and good food, are all important. (See p. 249.)

#### MUSCLES.

STRABISMUS OR SQUINT [Gr. στραβιζω, to squint,] is a loss of proper balance between muscles, so that when visual line of one eye is fixed upon object, that of other deviates more or less from it. Caused by anything which develops preponderance of power in a muscle, either directly or indirectly. May thus arise from some refractive anomaly; from

#### STRABISMUS.

anything which prevents binocular vision (cataract, corneal opacity, &c.) in which case the excluded eye yields passively to muscle which happens to be strongest; or from paralysis of muscles. Chief forms are convergent strabismus (eye deviating inward), and divergent strabismus (eye deviating outward.) An upward squint is called strabismus sursumvergens; a downward squint, strabismus deorsumvergens. Squint confined to one eye (monolateral); or may appear sometimes in one and sometimes in other (alternating). Range of motion of squinting eye may be curtailed, or it may be as great as ever-only displaced toward side of contracted muscle-as is usually the case in alternating squint. To determine which is squinting eye, direct patient to look at your finger held before him, and cover each eye alternately with your other hand. If uncovered eye remains fixed on object when other is covered, it is eye usually used for fixation. If it has to move to bring its visual line upon object, it is one which usually squints. Deviation of squinting eye when sound eve is fixed upon object is the primary deviation. Movement which sound eye makes when covered with hand, while squinting eye is made to fix its visual line upon object is the secondary deviation. When primary and secondary deviations are equal, and squinting eye accompanies healthy one in its movements, strabismus is called con

comitant. Strabismus measured by distance between two points marked on lower lid to correspond with the position of centre of pupil of squinting eye (1) when its visual line is fixed upon object, and (2) when visual line of other eye fixes object. Instruments for noting this distance called strabismometers. When squint is monolateral, squinting eye is frequently amblyopic, from habit patient acquires of unconsciously suppressing its retinal image, so as to be rid of the diplopia (?). In alternating strabismus, first one eye deviates and then the other, and vision of both may remain equally good. Strabismus is at first accompanied by diplopia, but this usually disappears later (p. 54.)

Convergent or Internal Strabismus: is due to hypermetropia in great majority of cases. In H. the accommodation is constantly called into excessive action, and this is always associated with increased convergence. In attempting to increase accommodation, so as to gain clear vision, one eye squints inward. first, squint may be periodic, appearing only when close work is undertaken; but it soon becomes permanent. Convergent squint is most frequent in moderate degrees of H, where sight is markedly improved by these increased efforts of ciliary and interni muscles. Very rarely it occurs in moderate degrees of myopia, where eyes are much used at fine work, and internal recti become permanently contracted from excessive use. It may also occur from division or paralysis of external rectus (p. 150).

Divergent Strabismus; is most frequently accompanied by myopia. In myopia strong convergence often required, yet difficult from shape of eyeball, and internal recti become strained and weakened allowing eye to deviate outwards (p. 162). Also, when one eye is blind or very defective the impulse to binocular vision is lost, the internal rectus grows weak and divergence occurs. It may also be produced by division, paralysis, or defective innervation of opposite muscle (p. 151).

Treatment for concomitant squint (which must always be carefully distinguished from the paralytic) consists in dividing tendon of shortened muscle. This weakens muscle by allowing its tendon to recede and acquire new insertion further back on sclerotic, and so, indirectly, strengthens opposite muscle. Where deviation is great, it is often necessary to operate on both eyes, to obtain full correction. After operation (p.78), suitable glasses should be worn to correct the refraction and prevent

recurrence of the squint.

PARALYSIS OF THE NERVES SUPPLYING THE MUSCLES:—One or more of the nerves may be affected, and paralysis may be total or partial (paresis). A fixed squint may result; or the trouble may be difficult to de-

:::

# FARALYSIS OF MUSCLES.

be no only manifest by diplopia and ima remain direction. Causes It may result from serebral or orbital from syphilis, rheumatism, &c. A transfer frequent cause. Mode of resident mivements was given at generally shows which as a certain form of it .. . . . . cach different paralysis. If and the second is present, it is distinguished my to instant form by fact that secondary and strater than primary, instead of strain to it. This results from fac The seri innervation of paralysed muscl sees a greater effort than normal to brin t great position t and this being resyrumizmente secondary deviatio the first names is the most from the complete or partial, and affine the transhes. In complete partial droops picsis) and eyel in a control of external rectus and s normissiks, which draw it outward an care movements caused by s the recti and inf. oblique being absoluted and immovable, and accomesta Vicro is crossed diplopia. remayers, all above symptoms cesser degree, or only some filam ... . may be affected, and loss of y

be thus confined to one or two muscles. If branch to int. rectus is paralysed there is deficient mobility inward and crossed diplopia, images being on same level and parallel. If sup. rectus is paralysed, there is impaired motion upward and inward, and diplopia occurs above horizontal line, images being crossed, and diverging at top, false one standing above true. If inf. rectus is paralysed, there is impaired motion downward and inward, and diplopia appears below horizontal line. Images are crossed, false one standing below true, and they converge at top.

Paralysis of fourth nerve: paralyses sup. oblique muscle. There is impaired motion downward and outward, and homonymous diplopia below horizontal line. Images converge at top and false one stands below true.

Paralysis of sixth nerve: paralyses ext. rectus. There is impaired motion outward and homonymous diplopia, images being on

same level and parallel.

Treatment of paralysis must depend on cause. Electricity sometimes of use. To relieve patient from diplopia, affected eye may be covered with shade, or a prism worn to fuse images. If all treatment fails, division of opposite muscle and re-adjustment of affected one may be performed (vide p. 79).

NYSTAGMUS [Gr. wortaynos, a nodding?):
is marked by involuntary, spasmodic oscilla-

it by inclining head in directio that in which eyeballs oscillate generally appears in infancy, it clear vision is difficult (on accorpacities, refractive defects, and impulse to proper innerval sened. Seen in coal miners, undue strain. Treatment chie tic, as little can be done after cablished. Whatever improves to improve nystagmus.

tablished. Whatever improves to improve nystagmus.

MUSCULAR ASTHENOPIA; 1
OF INTERNAL RECTI. Occurs high degrees of myopia, which can convergence and over-taxing of so occurs in general muscular rarely, in hypermetropia. Causthenopia when fine work is atterfor insufficiency were given a power of recti interni and extented for near and distant visit

### DISEASES OF EYELIDS.

inches. Prisms, base inward, to relieve strain upon interni. If these means fail, division of external recti to weaken their power. Advisability of operating on one or both of the externi depends on degree of insufficiency and on power of abduction.

#### EYELIDS.

The eyelids are subject to same affections as other parts of general integument—such as hyperæmia, ædema, inflammation and abscess, erysipelas, acne, hærpes, eczema, warts, nævi, syphilitic ulærs, cancer, &c. These require same general treatment here as elsewhere. Special danger to be guarded against is that of inflammatory and cicatricial changes which easily produce deformity of lids with all its bad results.

BLEPHARITIS MARGINALIS OR CILIARIS [Gr. βλεφαρον, eyelid]; TINEA TARSI; OPH-THALMIA TARSI:—Essentially an inflammation of hair-follicles along edge of lid, but other structures soon become involved also. Edge of lid is at first hyperæmic; and later, swollen, smooth and glossy. Discharges form small, yellow scabs, which glue lashes together in little bundles. Little pustules appear about roots of lashes, which may leave small ulcerations and fissures. Hairs fall out,

and new growth is apt to be thin, stunted and misdirected. If disease progresses, edge of he may become hypertrophied and callous, constituting tylesis [Gr. roly, callus]; and it may also be everted. Hairs may cease to grow altogether, leaving lid bald-madarosis, ். . . . . . . . . . . . Disease occurs in course of Sther indummations; from exposure to irritating induences; in general debility, from whatever cause: and is most common among poor and dirty classes. Is often associated with some refractive anomaly, and disappears when this is corrected. Is very obstinate and recurrent. In Treatment, cleanliness is of first importance. Crusts should be washed away several times a day with warm water or alkaline letten (such as to grs. soda to 3 i.); after significant seems astringent should be applied. Wask comme comment and red oxide mercury comment are among the best. Solutions of means of siver applied along roots of lashes are very useral. Refraction should always be meetally assessed and corrected if at fault.

However Lat. Merdeelus, a styel of Stys. Is a bed affecting connective tissue near cape of lid. Sometimes several appear at once, and there is often a succession of them. They may great swelling of lid, and considerable that. When supportation and sloughing occurrent the feltiles are liable to be destroyed and neutronal deformity may be left. Treat

until pus forms, when tumor should be firmly grasped between thumb and finger, and opened by incision parallel to edge of lid. General health almost always requires attention. Styes sometimes seem to be aborted, if they are touched, when first noticed, by nitrate of silver, or some astringent ointment applied. Sometimes it is useful to incise

them when they first appear.

CHALAZION [Gr. xahaça, hail]. TARSAL Cyst: -Is occasioned by obstruction of orifice of sebaceous gland and retention of secretion. A tumor is thus formed in cartilage, generally about size of pea, and situated near conjunctival surface, so that it becomes prominent when lid is everted. Overlying skin of natural color and freely movable. If inflammation has occurred, cyst will contain pus; otherwise it will be filled with gelatinous, fatty material. Name applied also to chronic stye. Treatment—To evacuate cyst through conjunctiva or skin according to circumstances. A free incision is made into tumor. and if contents are purulent they readily escape. If not, a curette is used to empty sac, and its walls are cauterized or irritated so as to obliterate it. Or, entire sac may be carefully dissected out.

The lids are subject to several deformities produced by chronic inflammation, and by ulcers, burns, injuries, etc., which cause loss

of tissue and cicatricial contractions:

long, cilia will be bleached by coing in secretions, and may be looked.

ENTROPION [Εντροπη, a turning a turning in of free edge of lid a It is sometimes spasmodic, fi orbicularis, especially in old p skin.

ECTROPION [Gr. Εκτροπη, a t is an eversion of lid, exposing i surface.

All above conditions keep constant irritation and discommost commonly seen in the variety of operations are perfocure, a choice of which is requirements of each case. In porary relief is obtained by

fications, is very commonly performed. (See p. 249.) The operation of "scalping," sometimes done in inveterate cases, consists in dissecting off all the cilia with their bulbs, leaving the lids permanently bald. Many cases of ectropion result from injury and cicatricial contraction, requiring plastic operations.

PTOSIS [Gr. πτωτις, falling] is a drooping of upper lid, either partial or complete. Caused by injury of levator muscle; swelling, and increased weight of lid from inflammation; or by paralysis of 3d nerve (p. 150). Sometimes seen in old-people from great relaxation of tissues. Rarely it is congenital.

PARALYSIS OF ORBICULARIS MUSCLE is a result of paralysis of portio dura of 7th nerve. Lids cannot be completely closed, and patient thus has a peculiar staring appearance called lagophthalmos [Gr. λαγως a hare, and οφελλμως, εγε]. The lower lid falls away from globe so that tears run over, and eye suffers from constant exposure to external irritants.

BLEPHAROSPASM: A spasmodic contraction of orbicularis, so that lids are firmly pressed together against globe. Occurs where photophobia is marked, and presents all grades of severity. It is reflex from irritation of 5th nerve and occurs in neuralgia of its branches; in inflammation of conjunctiva or cornea; from foreign bodies; in hyperaesthesia of retina, &c. Treatment consists primarily in removing cause. Other remedies are hypo-

dermic injections of morphia; immersion of face in cold water; canthoplasty; conium given until poisonous effect appears, etc. In neuralgia of 5th, division of affected nerve sometimes practised.

NICTITATION [Lat. Nictitatio, winking.]
A spasmodic contraction of orbicularis shown
by frequent twitching and blinking of lids.
Seen generally in weak and nervous patients.

ECCHYMOSIS of lids is effusion of blood into cellular tissue producing "black eye." Blood undergoes discoloration before it is absorbed, turning green, yellow, etc. To hasten absorption, cold applications, stimulating lotions, and compress bandage are useful.

INCISED AND PUNCTURED WOUNDS, BURNS, etc., should be very carefully dressed, especially if they involve cartilage, lest deformity of lids may result from healing.

EPICANTHUS [Gr. επι, upon, and παν 205, angle of eye]: Congenital malformation in which crescentic fold of skin passes from nose to eyelids, overlapping inner canthus more or less.

COLOBOMA: Congenital fissure of lid; sometimes associated with coloboma of iris and choroid, hair lip, cleft palate, etc. (See p. 250.)

## LACHRYMAL APPARATUS.

STILLICIDIUM LACRYMARUM [Lat. stilli-cidium, dripping, and lacryma, tear]: EPI-

PHORA [Gr. επι, upon, and φερω, to bring?]: WATERY EYE .- Is a condition common to nearly all lachrymal diseases. Caused by any impediment to efflux of tears through tear-passages, whether a simple displacement of puncta so that tears cannot enter them, or an obstruction in canaliculi, sac or ducts. Tears accumulate at inner angle of eye and flow over cheek, causing continual irritation and annoyance. Unless condition depends on some cause which can be otherwise removed, it must be remedied by operation. Method of opening canaliculi and probing nasal duct given at p. 79. Syphilis plays an important part in causation of lachrymal diseases, and should always be looked for.

DACRYO-CYSTITIS [Gr. Aukpvov, tear, kvotus, bladder]: ACUTE INFLAMMATION OF LACH-RYMAL SAC:—ABSCESS OF SAC:—May result from conjunctivitis, nasal catarrh, exposure, injury, chronic disease of tear-passages, etc. Is attended by great pain, tenderness, redness and puffy swelling over sac and extending to lids. If disease progresses, skin becomes thinned and abscess bursts through it. Treatment.—Opening of canaliculus so as to give free exit for pus and prevent perforation through skin. If latter is imminent, free incision should be made through skin into sac, and kept open until abscess is completely drained. If perforation has already occurred,

LACHRYMAL DISEASES.

canaliculus should be slit up and probes passed to open natural channels, and allow

external opening to heal.

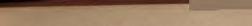
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CHRONIC INFLAMMATION OF SAC: BLEN-ORRHŒA OF SAC : MUCOCELE : [Gr. puros, mucus, and κηλη, tumor]. An insidious chronic inflammation of sac, resulting from acute or chronic inflammations of conjunctiva or nose, malposition of puncta, etc; and nearly always associated with strictures of lachrymal passages. These are most frequent at junction of canaliculi with sac, but may occur at any other point. There is constant epiphora and irritability of eye. Swelling of sac varies, and, if it is pressed upon, viscid mucus oozes out through puncta. Treatment consists in opening canaliculi and relieving strictures of passages by probing or incision. Astringent fluids injected into sac sometimes of benefit. Treatment moderately successful, but must often be very protracted, and some cases never recover. For extremely troublesome cases, with caries of bones, an operation to obliterate sac is sometimes performed.

FISTULA OF THE LACHRYMAL SAC: is an external opening through skin, left generally by inflammation. Often associated with strictures of passages and caries of bone. Treatment aims to re-establish natural communica-

tion through nose.

DISEASES OF THE LACHRYMAL GLAND are very rare. They comprise inflammation of



### REFRACTION AND ACCOMMODATION, 161

gland, dacryo-adenitis, usually chronic: cysts of gland, dacryops [Gr. δακρυου, tear, and ωψ, eye], usually due to closure of excretory ducts and distention from secretion above: fistula of gland, generally resulting from abscess, dacryops or injury; and cancer. Extirpation of gland is sometimes performed.

### ANOMALIES OF REFRACTION AND ACCOM-MODATION.

The refraction of an eye is its faculty of bringing paralell rays of light to a focus upon its retina without any effort of accommodation, and depends on the form of the globe and its refractive media.

The accommodation of an eye is its power of adjusting itself for vision at different distances—that is, for rays of different degrees of divergence. Nature of accommodation and method of measuring it given at p. 46.

EMMETROPIA. E. [Gr. εν, within, μετρου, measure, and ωψ, eye]:—that state of refraction in which parallel rays are brought to a

focus upon retina when eve is at rest.

HYPOMETROPIA or BRACHYMETROPIA [Gr. υπο, under, or βραχυς, short, μετρου, measure, ωψ, eye]: that state of refraction in which, with eye at rest, parallel rays are focussed in front of retina, only divergent rays being united upon latter. Usual name for this condition is



162 MYOPIA.

MYOPIA [Gr. μυω, to wink, ωψ, eye] from nabit such patients have of nipping eyelids together

to see more distinctly.

HYPERMETROPIA [Gr.  $in \epsilon \rho$ , beyond,  $\mu \epsilon \tau \rho o \nu$ , measure,  $\omega \psi$ , eye]: that state of refraction in which, with eye at rest, parallel rays are focussed behind retina, only convergent rays being united upon latter.

ASTIGMATISM [Gr. a, privative, and στιγμα, a point]: that state of refraction in which, with eye at rest, rays from a point are not re-

united in a point. (See p. 166.)

AMETROPIA [Gr. a, privative, μετρον, measure, ωψ, eye]: name applied to all refractive conditions which deviate from emmetropia.

ASTHENOPIA [Gr. ao 2 evns, weak, and wy, eye], or WEAK SIGHT; name for a group of symptoms often seen in the various refractive defects. After reading, writing, &c., for any length of time. letters become blurred and run into one another, eye grows red, watery, hot, painful or fatigued. Symptoms vanish when work is laid aside, to recur again as often as it is resumed. This may continue indefinitely until the cause is removed.

MYOPIA. M. (p. 161.) Caused generally by too great length of optic axis; exceptionally, by too high refractive power. Often hereditary or congenital; may be acquired from prolonged straining at fine work. Is stationary or progressive; in former case, generally of low degree and causes little annoyance; high grades apt to be progressive, and, if so, are associated with marked irritation and asthenopia. Far-point of distinct vision lies nearer eve than it should. Beyond this point, all objects appear indistinct. Farpoint expresses degree of the M; for instance. if patient cannot see clearly beyond 24 inches he is said to have M 14. To see distant objects, the rays, before entering his eye, must be made to diverge as if they came from a point 24 inches away, as thus only can they be united on his retina. This is done by concave glass of 24 inches focus. With ophthalmoscope, details of fundus of a highly myopic eye can be seen by direct method at some distance away; and if head is moved to one side objects of fundus are seen to move in contrary direction. This is due to fact that, in such cases, an aerial image of fundus is formed by refractive media of eye itself at distance corresponding to M. For example, in M 1, at 3 inches in front of eye. To get clear view of fundus in erect image, a certain concave glass must be used behind mirror. Focal length of this glass, plus its distance from nodal point of observed eye, equals the By indirect method, disc and vessels appear smaller than in E. Posterior staphyloma is often seen around disc, and is called myopic arc or crescent (p. 121). (See p. 250.) Treatment. General directions are to avoid

#### HYPERMETROPIA.

everything which tends to congest eyes, such as reading in stooping or recumbent posture, by faulty light, &c. Refraction is corrected by concave glasses which render parallel rays divergent enough to be united on retina. It is the rule to give the weakest glass with which best vision is obtained. Myopic eyes

frequently amblyopic also.

HYPERMETROPIA. H. (p. 162). Caused generally by optic axis being too short; exceptionally by refractive power being too low. May be congenital and hereditary: is acquired by senile changes in eye and by aphakia. Eye cannot see distant objects clearly without using a convex glass, or (what amounts to same thing) a certain amount of accommodation. Nearer the object, greater the strain upon accommodation. This leads to overtaxing of ciliary muscle and asthenopia, if eyes are much used at fine work. May also cause strabismus (p. 146).

Manifest H: is that which is evident with-

out paralysing accommodation.

Latent H: that which is habitually concealed by accommodation, but appears after latter has been paralysed by atropine. Latent H tends to become manifest as age advances.

Facultative H: that variety in which patient can see distant objects clearly with or without convex glasses, and can do fine work easily without glasses. Relative H: far and near objects are clearly seen, but only by converging visual lines to point nearer than object—by giving eyes periodic squint.

Absolute H: neither near nor distant objects can be seen clearly without convex

glasses.

The strongest convex glass through which patient obtains his maximum acuteness of vision for distant objects represents his manifest H. If accommodation is paralysed by atropine, the strongest convex glass which gives greatest acuteness of vision represents total H, including latent, if any existed. With ophthalmoscope, details of fundus may be seen by direct method some distance away, and if head is moved to one side they are seen to move in same direction. On going closer, a certain convex glass will be needed behind mirror to get a clear erect image: and focal length of the glass, minus its distance from nodal point of observed eye, equals exact degree of H. Field of vision larger and image smaller than in E. By indirect method, disc and vessels look larger than in E. See p. 250.)

Treatment consists in correcting refraction by suitable convex glasses. In manifest H, we may give for distance the strongest glass which gives the patient his most distinct vision. In latent H, no fixed rules can be given. It is usually necessary to begin with a weak glass

and advance gradually.

ASTIGMATISM. As. (p. 162): depends on want of symmetry in refracting surfaces, so that refraction differs in different meridians. and retinal image is thus confused. Generally congenital, and may be hereditary; is acquired, by inflammation of cornea, faulty union of corneal incision after an operation, use of improper glasses, &c. Meridians of greatest and least curvature are called chief or principal meridians. Astigmatism caused by different focal lengths of principal meridians is called regular. That caused by differences of refraction in same meridian is called irregular. Latter form comes from irregularities in structure of lens or cornea, either original (normal irregular astigmatism) or acquired through disease (abnormal irregular astigmatism): chief subjective symptom is monocular polyopia (eye seeing more than one image), and metamorphopsia: objective symptoms are irregular corneal reflections and changes of curvature, sometimes visible by oblique illumination, distorted appearance of objects of fundus, with parallax: irregular astigmatism cannot be corrected by glasses, but is sometimes improved by stenopæic apparatus. Regular astigmatism is simple when one chief meridian is emmetropic and the other ametropic; compound when both are myopic or hypermetropic, but defect is greater in one than in other; mixed when one chief meridian is myopic and the other hypermetropic. Astigmatism is corrected by means of cylindrical glasses (p. 50). (All eyes are naturally astigmatic, the curvature being slightly stronger in vertical than in horizontal meridian. No inconvenience is usually felt unless As, is  $\frac{1}{40}$  or more.

PRESBYOPIA. Pr. [Gr. πρεσβυς, an old man, ωψ, eye]: FAR SIGHT: Name applied to condition of diminished range of accommodation seen in elderly people. Consists in a recession of the near point due to changes in ciliary muscle and lens, so that accommodative act can no longer render latter as convex as before. First symptom is that small objects cannot be seen clearly at so short a distance as formerly, but must be held further away from eye, especially in evening. Distant vision, however, remains unimpaired. Recession of near-point begins in all eyes in youth and gradually progresses during life. Does not usually cause inconvenience until after 40. Appears earlier in hypermetropic eyes. Presbyopia is assumed to begin when near-point has receded beyond 8 inches. Degree of Pr. is found by deducting patient's near-point from this. Thus, if p lies at 16 inches, Pr.=1-16-16. Pr. is easily corrected by convex glasses for reading, and they should be given as soon as the affection appears. Usual to give weakest glass which renders work comfortable at proper distance.

### 168 PARALYSIS OF ACCOMMODATION.

Differences in the refraction of the two eyes often occur, and are of great variety. Adjustment of glasses to such cases is largely a matter of experiment. As a rule, glasses which differ by more than  $\frac{1}{40}$  are not well borne. Condition is called anisometropia.

APHAKIA [Gr. a, privative, and panos, lens]; ABSENCE OF CRYSTALLINE LENS: May be congenital or result from absorption of lens after injury, removal by operation, or dislocation. Refractive power of eye thus very much lessened. Accommodation, as a rule, entirely absent. Exceptional cases have occurred where some accommodation remained in lensless eye. Very strong convex glasses required for close work, and somewhat weaker ones for distance. When lens is gone natural corneal astigmatism becomes apparent.

PARALYSIS OF ACCOMMODATION sometimes seen in general debility of system. Frequent after diphtheria. May be complete or partial. Is usually attended by dilatation of the pupil. Causes marked inconvenience in emmetropic eyes, as the recession of the nearpoint renders the patient unable to do any close work. Distant vision, however, is not impaired. In hypermetropes, both near and distant vision are disturbed. In myopes the impairment of vision is less, as they are

still able to see clearly at their far-point, which may be only a few inches from the eye, e.g., in M<sub>1</sub>. Convex glasses restore the vision for near objects at once. Diagnosis is easily made if range of accommodation is tested. Treatment consists primarily in removing any apparent cause—such as general debility. Iodide of potash sometimes useful. Some myotic, locally, may be beneficial.

SPASM OF CILIARY MUSCLE (apparent myopia): Sometimes occurs in ametropia, especially in H., and also in emmetropia following upon undue straining of accommodation. Causes asthenopia and dimness of vision for distant objects. Latter is perfectly relieved by weak concave glasses. The true state of refraction may be found by the ophthalmoscope; or, if there is doubt, atropine may be used. Treatment: strong sol. atropine until spasm is completely overcome.

SIMULATED BLINDNESS: Often met, and sometimes very difficult to detect. Simulated blindness of one eye may be detected by holding a prism before healthy eye, when, if patient sees two images, simulation is proved. If eye is truly blind, pupil should be partly dilated and insensible to light when healthy

eve is closed; but when latter is exposed to light both pupils should contract together. Stereoscope also used, with slides having two different kinds of print or figures upon them, which are so arranged as to undergo a transposition when seen through the instrument. Thus, if patient is simulating blindness of his right eye, he will naturally say that he sees only the left-hand figure in the stereoscope; but this really belongs to the right eve. and so the fraud is exposed. Various trials with test-types and glasses (noticing whether patient's statements are consistent) are useful. When atropine has been put into eye for deception, pupil is noticed to be dilated ad maximum, and does not act with that of other eye. In absolute blindness of both eyes. pupils should not contract under bright

PHOTOPSIA [Gr.  $\phi\omega s$ , light, and  $o\psi ssight$ ]; PHOSPHENES: Flashes of light, fiery sparks, luminous rings, etc., which patients describe as seen before their eyes. They occur in retinal inflammations, after blows upon

eye, etc. Also occur in blind eyes.

MICROPSIA [Gr. μικρος, small, and οψις, sight]: Objects appear smaller than they really are. Occurs in diseases which disturb rods and cones of retina.

METAMORPHOPSIA [Gr. μεταμορφοω, to transform]: Objects appear distorted. Occurs in retinal disease and in irregular astigmatism. COLOR-BLINDNESS; DALTONISM. [After chemist Dalton, who first described it.] Is an inability to distinguish colors, and is of variable degree. Congenital, or result of discase, especially of atrophy of optic nerve. May also be produced by long-continued strain of eyes in working at colors. If only two of the three primary colors can be seen, condition is called dichromic vision. Where no color can be distinguished, condition is called achromatic vision. Is more frequent in males than in females. Red-blindness is most frequent form. (See p. 53.)

Herpes zoster ophthalmicus, or ophthalmic herpes, affects the skin supplied by the ophthalmic division of the 5th or trigeminal nerve,—that is, the forehead, upper lid, and side of nose. It never crosses the median line. The eruption of herpetic vesicles is generally attended with pain. There may be corneal ulceration and iritis, with photophobia and lachrymation. Most frequent in old people. Cold a common exciting cause. Disease obstinate. May leave deep scars, severe neuralgias, and anæsthesia of skin and of cornea. Treatment not very satisfactory. Comprises atropine, evaporating lotions, tonics, etc.

# PART II.

OTIC MEMORANDA

### CHAPTER I.

### ANATOMY AND PHYSIOLOGY OF THE EAR.

THE auditory apparatus consists of a complicated structure (the ear) for collecting sonorous impressions, and conveying them to the auditory nerve, which transmits them to the brain. Delicate parts of the ear are securely imbedded in the petrous portion of the temporal bone. The sound-waves are collected by the auricle, conveyed through the ext. auditory canal, and received upon the membrana tympani, which is thrown into corresponding vibrations. These vibrations are conveyed by the chain of bones through the tympanum to the fluid of the labyrinth, and so to the terminal auditory nerves. The impressions there received are transmitted to the brain, where they are perceived as sound. The membrana tympani is so arranged as to undergo variations of tension in accordance with the different kinds of waves which strike The pressure of the air in the tympanic cavity is regulated by its communications with the mastoid cells, and with the pharynx through the Eustachian tube. The component parts of the terminal auditory apparatus in the cochlea are supposed to be tuned to vibrate in sympathy with all the different notes which are appreciable in our musical scale. The semicircular canals have been considered as governing the equilibrium of the body and as having little or no part in function of hearing. [Buck suggests that they may serve as safety-valves to protect the terminal apparatus from injury in cases of very loud or sudden noise, where the stapes is driven violently against the fenestra ovalis.] Our knowledge of the physiology of audition is still incomplete on several points.

THE ANATOMY OF THE EAR may be conveniently divided, for the sake of description, as follows:—

I. External ear. \( \begin{pmatrix} (a) Auricle. \\ (b) External auditory canal. \end{pmatrix}

II. MIDDLE BAR. (a) Membrana tympani. (b) Cavity of tympanum. (c) Mastoid cells. (d) Eustachian tube.

III. INTERNAL EAR. (a) Vestibule. (b) Semicircular canals. (c) Cocklea. (d) Auditory nerve.

### EXTERNAL EAR.

Auricle [Lat. auris, ear] or pinna [Lat. pinna, a mussel]:—is external funnel-shaped ap-

### AURICLE.

pendage fastened to malar and temporal bones by elastic fibres. Has fibro-cartilaginous framework closely covered by perichondrium and skin. Latter forms projection from lower end of cartilage called lobe of ear. Outer edge of auricle called helix [Gr. ¿λίσσω, to twist]. Within helix is fossa navicularis [ Lat. navicula, small boat]. At inner edge of this is another ridge, the anti-helix. In front of opening of auditory canal is projection called the tragus | Gr. Tpayos, goat: because hairs like goat's beard usually grow here? | Opposite this on other side of canal is similar projection, the anti-tragus. Concavity around orifice of canal called the concha. [Gr. Koyyn, concave shell. Above this is triangular depression, the fossa triangularis. Skin of auricle covered by downy hairs, and contains sebaceous glands (largest in concha), and sweat-glands (chiefly on side next skull).

# Muscles of Auricle.

Levator or attolens aurem: O. aponeurosis occipito-frontalis. Fan shape. Fibres converge to I. at upper part of auricle. Lifts auricle. Supplied by small occipital nerve.

Attrahens aurem: O. lateral edge aponeurosis occipito-frontalis. I. in front of helix. Draws auricle forward and upward. Supplied by facial and auriculo-temporal branch of infimaxillary nerve.

Retrahens aurem: O. mastoid proces short aponeurotic fibres. I. lower part claim surface of concha. Draws auricle bward. Supplied by post auricular nerve facial.

[Above muscles rudimentary in man.]

Intrinsic muscles: muscles of animal Slightly developed; sometimes absent: Tragicus: lies on ant. surface ant. wa

cartilage auditory canal.

Anti-tragicus: lies on post. surface; wall of cartilage auditory canal.

Helicis major: runs over ant. margin land passes into levator aurem.

Helicis minor: lies on lateral surface

between its root and spine.

Transversus auriculæ: runs on post. face auricle from navicular fossa to cor across furrow corresponding to anti-helix

Obliquus auriculæ: runs on post. sur auricle over furrow corresponding to 1 root anti-helix.

Dilator of concha: on tragus.

## Arteries of Auricle.

Post. auricular from ext. carotid Ant. auricular from temporal. Auricular branch from occipital. Veins empty into temporal, ext. jug and post. facial. Network of lymphatic

# Nerves of Auricle.

Auriculus magnus, from cervical plexus, on post. surface auricle. Post. auricular from facial. Auricular branch from pneumogastric. Auriculo-temporal branch from inf. maxillary.

External auditory canal. Meatus auditorius externus [Lat. equiv.] :- Runs from auricle to membrana tympani, forward and inward, crooked course, principal curve having convexity upward, so that canal is higher in middle than at either end. Average length about I in. Width varies; widest parts at junction of bone and cartilage, and close to membrana tympani. Outer a cartilaginous, continuous with cartilage of auricle, and interrupted by fissures, incisuræ Santorini, filled with fibrous tissue. Inner 3 bony, part of tem-poral bone. [Sup. and post. walls developed from temporal bone in general growth of skull; ant, and inf. walls from tympanic ring or annulus tympanicus [Lat. equiv.] of fœtus,—an oval bony ring, with upper 1 wanting, which is independent at first but finally joins with rest of bone. At birth, no bony canal exists, it being represented by membrane, which disappears as bone grows outward.] At bottom of canal, in annulus tympanicus, is tympanic groove sulcus tympanicus, [Lat. equiv.] for insertion of membrana tympani. Groove and ring interrupted above by a segment of irreg-

ular outline, about  $\frac{1}{10}$  in high and  $\frac{1}{10}$  in wide, the segment of Rivinus [Rivinus, Leipsic, 18th cent. Each end of segment marked by projecting bony spine. Helmholtz [Berlin, 19th cent.] calls ant. point spina tympanica major (spina tymp. posterior of Henle) and post. one. spina tympanica minor. Owing to oblique position of membrana tympani, ant. and inf. walls of canal are longest. (p. 181). Canal lined by integument containing soft hairs, sebaceous and ceruminous glands. Latter are like sweat-glands. Cerumen [Lat. for wax] consists chiefly of fat and coloring matter. Integument becomes thinner as it approaches membrana tympani. Canal in relation in front with articulation lower jaw; in front and below with parotid gland: behind with mastoid cells and transverse sinus: above with mastoid cells. dura mater, and middle fossa of skull.

Vessels:—Post. auricular artery; deep auricular from int. maxillary, entering at articulation lower jaw. Largest vessels run on upper and post. walls.

Nerves from 3d branch 5th and from pneumogastric, entering through ant. wall.

#### MIDDLE EAR.

Membrana tympani or Drum-head. Lies at bottom of ext. auditory canal, separating it

from tympanic cavity. Placed chliquely, forming acute angle (45°) with inf. and ant. walls of canal and obtuse one with sup, and post, walls. Upper border about 1 in. nearer to entrance of canal than lower; post. border about in. nearer than ant. [In infant lies more horizontally and nearly in line with upper wall of canal.] Of ellipsoidal shape with long axis (about 1 in.) downward and forward. At upper part presents conical protrusion,-apex corresponding to short process of malleus, and base spreading out in front and behind, forming anterior and posterior folds, anterior being the shorter one. General position of membrane is arched, with concavity outward. Deepest concavity surrounds end of malleus-handle and is called the umbo [Lat. for boss, of a shield.]. Membrane inelastic, about 280 in, thick, and composed of 3 layers :- a middle fibrous layer, covered externally by skin of auditory canal, and internally by mucous memb. of tympanum. Dermoid layer very thin and devoid of hairs and glands. Middle layer, lamina propria presents two layers of fine fibres, an outer radiating and an inner circular. In ant. half of memb. outer fibres radiate from tip of malleus as centre; in post, half they radiate from entire length of malleus-handle. In centre of memb. circular fibres form very thin layer which grows thicker towards periphery and there becomes thin again or disappears. Between some of the fibres are cells-corpusces of Von Tröltsch. [ Anton Von Tröltsch, Würzburg, 19th cent.]. Short process and handle of malleus embedded between radiating and circular fibres (p. 186). On tympanic side of memb. is fibrous fold \( \frac{3}{25-25} \) in, high and \( \frac{4}{25} \) in. broad, running from post. and sup. border of bony ring (p. 179) to handle of malleus. forming a pocket opening downward. Called the posterior pouch. There is similar space in front of malleus, the anterior pouch, formed by spina tympanica major (p. 180), long process malleus, mucous memb., ant. ligament malleus, chorda tympani nerve and inf. tympanic artery. At margin of drumhead, its layers unite to form tendinous ring, which is inserted into sulcus tympanicus (p. 179). Tendinous bands run from end of Rivinian segment to short process of malleus, and above these is triangular space, including Rivinian segment, and filled by dermoid and mucous layers, more flaccid than remainder of membrane. Called membrana flaccida or Shrapnell's membrane [H. J. Shrapnell, London, 18th cent.] Minute opening supposed by some to exist in this part called Rivinian foramen.

Blood-vessels: To outer layer from deep auricular artery. To inner, from vessels of tympanum. Two layers communicate by

capillary network in middle layer.

Nerves in all layers: In outer, from super-

ficial temporal of 5th. In inner, from tympanic plexus and nerves of cutis.

Lymph vessels found in all layers.

Seen through the auditory canal, the normal memb, tympani presents a delicate, bluishgray color and is quite translucent. Short process of malleus appears as a whitish tubercle at upper border, and handle of malleus as a whitish stripe running from this down and back towards the centre of the memb., dividing it into ant. and post. parts, of which the former is the larger. The "light-spot" is a bright, triangular reflection with its apex towards the tip of the malleus-handle and base (%-16 in. broad) towards the periphery of the memb. It results from the oblique position of the memb, and from its marked concavity at this point. Sometimes one or two fine vessels may be seen, especially along the malleus-handle.

Cavity of tympanum or drum of the ear. [Lat. tympanum, drum]:—Irregular, air-containing space lying behind drum-head. Lined by mucous membrane continuous with that of Eustachian tube and pharynx. Average diameters; antero-posterior  $\frac{1}{2}$  in.; anterior vertical  $\frac{1}{4}$ - $\frac{1}{4}$  in.; post. vertical  $\frac{3}{4}$  in.; anterior transverse  $\frac{1}{4}$ - $\frac{1}{4}$  in.; transverse opposite drumhead  $\frac{1}{4}$  in. Folds of mucous memb. stretch from one bony point to another, in some places

from it by thin plate of b which ends by small project processus cochleaformis. P ates tympanum from mas sents openings into cells a under roof. Outer wall co drumhead, but extends fur upward than this; has 3 o chordæ posterius, [Lat. ites with centre of drumhead ar edge, the opening of a mint scends in front of Fallopian joinsit. Chorda tympaniner up under long process of in post, pouch, then forward : leus, and leaves tympanum anterius, or canal of Hugu front of memb, tympani ar

tunda [Lat. for round window], 1's in, diameter, leading into cochlea. Closed by membrane called membrana tympani secundaria. In front of fenestræ and extending between them is a rounded projection, the promontory, corresponding to first whorl of cochlea. Presents grooves for nerve-twigs. In front of promontory, wall very thin and covers carotid artery. Above and behind fenestra ovalis is a ridge corresponding to Fullopian canal which contains facial nerve. Behind and below fenestra ovalis is the pyramid, or eminentia Stapedii, a conical eminence containing circular canal which encloses stapedius muscle and communicates below with Fallopian canal. On level with fenestra ovalis and behind ridge of Fallopian canal is a smooth surface corresponding to horizontal, semicircular canal. Upper wall very thin (sometimes wanting) and separates tympanum from cranial cavity. Lower wall, sometimes very thin or wanting, separates tympanum from jugular vein. Pierced by glosso-pharyngeal nerve.

The Ossicles of the Ear, or Ossicula auditus [Lat. equiv.]: are three small bones—malleus [Lat. for hammer], incus [anvil], and stapes [stirrup], which form a chain across tympanum. Covered by very thin periosteum and mucous memb. Malleus presents head, neck, short process, handle or manubrium [Lat. for

Long process runs forward a wardGlaserian fissure; 31 line dwindled to a short stump in and neck of malleus attached fibres. Those running from major to neck of hammer and process up to Glaserian fiss mentum anterius mallei. from neck of malleus to box segment, ligamentum mallei e. running from head of malleus panum, ligamentum mallei posterior group of fibres of lig num called ligamentum pos with middle group of ligame called axis-band of hamme Head articulates with incus containing cog, which allows

with head of stapes. Joint is flat segment of sphere, convex toward stirrup. Stapes presents head, neck, crura, and base. Head articulates with incus. Base is surrounded by lip of fibro-cartilage and rests in fenestra ovalis; union between it and wall of vestibule is by periosteum of latter extended over base. A thin membrane inserted into side of base and inner edges of crura, closing opening between them, is called ligamentum obturatorium stapedium. Joints of ossicles provided with articular cartilages and capsules. Tensor tympani muscle arises from periosteum of upper wall of canal in which it lies, from upper wall of cartilage of Eustachian tube, and from neighboring border of sphenoid. Before leaving canalit becomes tendinous, and tendon turns around processus cochleaformis (p. 184) at nearly right angle, to be inserted into ant. half of inner side of hammer at beginning of handle and a little below short process. Supplied by nerve from otic ganglion. Draws handle of hammer inward and renders memb. tympani tense, and all the ligaments of the ossicles (except superius mallei) are simultaneously put on the stretch; at the same time the long process of the incus is made to rotate inward with the malleus handle, and so to press the stirrup against the oval window and fluid of the labyrinth. Stapedius muscle arises from cavity in pyramid in which it lies. Tendon leaves canal at obtuse angle and is inserted into neck of stapes. Surv by nerve from facial. Supposed to debase of stapes, and so compress con

of labyrinth. (See p. 251)

Arteries of tympanic cavity: Tymp branch int. maxillary, entering by Glase fissure. Stylo-mastoid branch post, auric entering by stylo-mastoid foramen. Pet branch middle meningeal entering by h Fallopii. Branches from ascending pharyi and int. carotid entering by median Eustachian tube.

Veins empty into mid, meningeal and

ryngeal.

Nerves: To muscles, q. vide. To mu memb. from tympanic plexus, which is for from tympanic branch (Jacobson's ne of petrous ganglion glosso-pharyngeal, tering by small foramen below promont from branch of superficial petrosal, ent from above; and from branches from ca plexus of sympathetic entering through wa carotid canal. The otic ganglion: situated foramen ovale of great wing of sphenoi front of middle meningeal artery, on outer of cartilage of Eustachian tube and orig tensor palati muscle, and internal to inf. illary nerve. Receives fibres from 3d div of 5th, from auriculo-temporal, and from pathetic plexus around mid, meningeal as Communicates with glosso-pharyngeal facial nerves through small petrosal.

branches to tensor tympani and tensor palati muscles. Chorda tympani nerve passes across tympanum (between handle of malleus and long process of incus and along lower margin of post. pouch of memb. tympani), but seems

to have no physiological relation to it.

The masioid cells consist of a large number of irregular cells, of varying size, contained in mastoid process of temporal bone. Whole are surrounded by dense cortical layer of bone \( \frac{1}{26} \) in thick. In upper part of process there is a single large cell, the mastoid antrum [Lat. antrum, cave], which communicates with lower cells, and from which one or more openings lead into tympanum through its anterior wall. Cells are lined by thin mucous membrane. [At birth mastoid process is rudimentary, and contains only one large cell, which corresponds to antrum.] Vessels of cells from stylo-mastoid branch of post, auricular. Nerves from tympanic plexus.

The Eustachian Tube [Eustachius, Venice, 16th cent.]:—Leads from pharynx upward, outward and backward to tympanum, at angle 135° with axis of ext. auditory canal. Consists of cartilaginous and bony portion, whole length being about 1½ in. Tympanic end is bony; triangular shape; about ½ in. long and ½ in. diameter. Outer wall belongs to pars tympanica, median wall separates tube from carotid canal, and upper wall, septum tubæ,

from canal of tensor tympani muscle. of union with cartilage is jagged, and me wall runs further back than outer. Cart of tube consists of two plates, a median t gular one, which is the larger, and whose upper and outer part is inserted smaller, hook-shaped outer one, which tached to base of skull. Remaining wall o part of tube (equal to about half its circ ference) is formed of membrane. Narro part of tube is at isthmus, the junction of tilaginous and bony parts. Pharyngeal o is trumpet-shaped, about \ by in. diam and lies in post, nasal space a little a floor of nostril. Inner wall projects sli into pharynx so that mouth of tube lies r in a frontal plane. Tube lined with my memb., which in bony part adheres closely to periosteum. Contains num acinous glands, which decrease toward panic end. Memb. quite thick at phary end. Epithelium ciliated, with motic cilia toward pharynx.

Muscles of tube: Abductor or dilate tube (spheno-salpingo-staphylinus, cir flexus palati, or tensor palati mollis): sphenoid bone and cartilage of tube. I. vex border of outer cartilage along its vength. Fibres pass forward, inward downward, and spread over edge of soft ate and side of pharynx. Draws hook of cartilage forward and downward, end

calibre of tube. Fibres said to pass into those of tensor tympani. Supplied by internal

pterygoid nerve.

Levator veli palati: O. lower surface of temporal bone on ant. border of entrance to carotid canal, and from cartilage of tube. I. in region of osseous tube on bone, cartilage and mucous memb. of tube. Presses membranous floor of tube forward, enlarging transverse diameter. Supplied by pneumogastric nerve.

Salpingo-pharyngeus: Thin muscular layer connected to lower end of median cartilage, to mucous memb, and post, wall of pharynx. Considered as fixator of median cartilaginous

plate. Called fascia by some.

Vessels of tube: Ascending pharyngeal from ext. carotid. Middle meningeal from int. maxillary. Branch from int. carotid.

Nerves of tube: - Branches to muscles q. vide. Sup. pharyngeal from 5th. Glosso-

pharyngeal.

Whether tubes are normally open or closed is disputed. They are opened during act of swallowing. A semi-cylindrical space under hook of cartilage is called safety-tube, and supposed to be always open.

### INTERNAL EAR, OR LABYRINTH.

Is the essential part of the hearing apparatus, containing the ultimate filaments of the auditory nerves. Comprises several osseous cavities contained in the petrous bone, within which are corresponding membranous sacs, receiving the distribution of the nerve. Sacs and intervening spaces are filled with a clear fluid.

BONY CAVITIES are: (1) Vestibule. (2)

Semicircular canals. (3) Cochlea.

VESTIBULE :- Irregular ovoid shape ; diameters from above downward and from behind forward about & in., and from without inward about 16 in. Outer or tympanic wall contains foramen ovalis (p. 184); above this, is anterior opening of horizontal semicircular canal. On inner wall, near upper ant. edge, are two depressions, recessus ellipticus and recessus sphæricus; small ridge separating them called crista vestibuli; crista runs above into pyramidal elevation, pyramis vestibuli; below, it divides into two branches, which enclose a space called recessus cochlearis: recessus ellipticus is partly bounded below by a shallow furrow, sinus sulciformis; just above recessus, ampullar orifice of ant, vertical semicircular canal opens; at post. part of inner wall is opening of aquaeductus vestibuli, a fine canal running into vestibule from post. surface of petrous bone; contains tubular prolongation of lining memb. of vestibule ending in the cranium between the layers of the dura mater. At junction of inner and post, walls 16 opening common to both vertical semicircular canals. At same level in middle of post, wall is post, opening of horizontal semicircular canal. In angle of post, lower and inner walls is lower opening of post, vertical semicircular canal. On ant. apex of vestibule below recessus sphæricus, and below ant, edge of fenestra ovalis, the scala vestibuli of the cochlea begins (p. 196). Maculæ cribrosæ [Lat. macula, spot, and cribrum, a sieve], for entrance of twigs of auditory nerve are on inner wall, but are only visible by microscope in adult. Each macula consists of a group of fine holes. The largest one, macula cribrosa superior, lies at upper end of crista vestibuli, and admits nerves to utricle and to ampullæ of ant, vertical and horizontal semicircular canals. Macula media lies in recessus sphæricus, and admits nerves to saccule. Macula inferior lies at ampullar opening of post, vertical semicircular canal, and admits nerves to ampulla. A fourth macula lies in upper part of recessus cochlearis, and admits twig of cochlear nerve to septum between utricle and saccule.

SEMICIRCULAR CANALS: are C-shaped, starting from vestibule and returning to it again. Horizontal one convex laterally. Other two are vertical (anterior and posterior) at right angles to each other. Five openings in all, one being common to both vertical canals; for situation in vestibule vide p. 180. Openings called ampulla, from flask-shape.

common to both munis, about  $\frac{1}{12} - \frac{1}{12}$  in. long. Professional close together, at about those of post. vertical stand other; those of horizontal close vertical.

COCHLEA:—So called from snail [Lat. cochlea, snail.]. coils around a central pillar o toward one extremity, where de-sac. About 1½ long, ½ in ginning and ½ in. at end. from below upwards, from le ear, and vice versa in left. directed forwards and outwroof. Cochlea is separated wall from carotid canal.

la-like section of a funnel, called infundibulum [Lat. for funnel]. Spongy substance is penetrated by numberless small canals which run outwards from base to spiral lamina, and allow passage of nerves and vessels from meatus auditorius internus. Two of the canals running in spongy substance have names. Their walls are perforated by fine holes corresponding to canals running to spiral lamina. One, canalis centralis modioli, begins in fossa cochlearis and runs in axis of modiolus from base to apex. The other, canalis spiralis modioli, or canalis ganglionaris, runs spirally along outer wall of modiolus at line of junction of lamina spiralis: oval form, separated from scala tympani by thin, cribriform lamella, and ends at apex near hamulus. Canals transmit vessels and nerves. In canalis spiralis lie ganglia of cochlear nerve. On outer surface of modiolus, and running spirally around its axis from base to apex, is a projecting bony ledge called lamina spiralis ossea. Made up of two lamellæ which at its base, where they come off from wall of modiolus, enclose spongy bone-substance, communicating with canalis spiralis modioli. Its free edge, where lamellæ approach each other, is thinner. Post, lamella-forms outer wall of canalis spiralis; anterior passes into wall of scala vestibuli. Lamina diminishes in width and thickness towards apex. In first whorl, projects into tube of cochlea to in., in last

whorl  $\frac{1}{h}$  in. At apex ends in bony hook, the hamulus [Lat. for small hook], projecting into The ductus cochlearis or lamina spiralis membranacea stretches from free edge of bony lamina across to outer wall of cochlear canal. A complete partition is thus formed dividing canal into two passages or scala [Lat. for stairways]. Lower scala has its base turned towards tympanum striking upon memb. tympani secundaria, and is called scala tympani. Upper one alone opens into vestibule(by recessus sphæricus) and is called scala vestibuli. At apex of cochlea the two scalæ open into each other and connect with arachnoidal cavity of brain; communication called helicotrema [Gr. έλισσω, twist, and  $\tau \rho \eta \mu \alpha$ , hole]. [Communication doubted by Buck.] Two small canals open by one end into labyrinth and by the other on surface of petrous bone: (1.) Aquæductus vestibuli, about & in. long, begins by groove just below and in front of opening of the two vertical semicircular canals, runs around inner wall of common canal, then down and back, and opens under bony projection a little behind middle of post, inner surface of petrous bone. Transmits small vein carrying blood from semicircular canals and emptying into vein of dura mater or into inf. petrosal sinus. Aqueductus cochleæ is somewhat larger; begins by small orifice in lower wall of scala tympani, just above fenestra rotunda, runs downwards, inwards and forwards in inner wall of jugular fossa, and opens at bottom of triangular depression towards middle of edge, which limits inner and inf. surface of petrous bone. Transmits vein carrying blood from

cochlea and empyting into jugular.

The periosteum of the labyrinth is, excepting that of outer wall of cochlear canal, very delicate. Consists of several layers of very fine fibrous network, compared by Henle to memb. suprachoroidea. In spaces of network are smooth round or elliptical nuclei, sometimes like epithelium. Also stellate pigment-cells and minute round or ovoid calcareous deposits. Rich supply of vessels. From periosteum of vestibule and semicircular canals fine fibres and many blood-vessels run to outer surface of corresponding parts of membranous labyrinth.

### THE MEMBRANOUS LABYRINTH.

The utricle [Lat. utriculus, a little leathern bottle]:—is a flattened elliptical tube placed upon inner wall of vestibule. Long diameter, in., corresponds to height of vestibule, upper end lying on pyramid, lower end lying opposite ampullar opening of post. vertical semicircular canal. Fastened to recessus ellipticus by fine vascular, nervous and connective-tissue network. Outer wall free and separated from outer wall of vestibule by space filled with endolymph.

Membranous semicircular canals of shape as osseous and open into utricle openings, as do osseous into vestibule. . pullæ, the membranous canals fill the os but in other parts there is considerable between the two, which is filled by conr tissue, vessels and fluid. Walls of cana of utricle are clear, transparent and ver cate; about 1200 in. thick, and compos (1) an outermost layer (memb. propria) culate and nuclear fibrous tissue piero bloodvessels; (2) a basal membrane; a an innermost layer of pavement epith On inner surface of walls of canals, exc side next to bone, membrane is throw numerous elevations. On wall of both and saccule is a more dense point, of c shape, 12 in diameter, the macula acr where twig of auditory nerve reach There is a still more rigid spot, the acustica, embracing about & circumfere ampulla, near its utricular orifice, of yel color, about by to in. diameter, some surrounded by pigment-line, and rec also nerve-twigs. Maculæ and cristæ p thickening of memb. propria from ming connective tissue and network of nervewhich enter epithelial cells (?).

The otolith of the utricle (otoconic sand, or ear crystal) [Gr. ovs, ear, and stone,] is a smooth, irregularly demarcal uneven reass of white powder, loose

together by mucoid substance. Powder consists of crystals of carbonate of lime, of varying form and size. Largest about  $\frac{1}{2\sqrt{000}}$  in. long and  $\frac{1}{2\sqrt{000}}$  in. broad. How otolith is held to

wall of utricle is not settled.

The saccule is a flask-shaped sac, whose body (about 15 in. diameter) lies in recessus sphericus, its blind base directed upward and forward against utricle, the walls of the two sacs being united at a single point. Neck of sac, canalis reuniens (about 15 in. long and 110 in. diameter), runs from lower wall down and back, and sinks into upper wall of vestibular end of ductus cochlearis at nearly a right angle, so that a blind sac is formed at junc-

tion of the two parts.

The ductus cochlearis begins with above blind sac in vestibule, and passes through whole cochlea to apex, where it ends in another blind sac. Lower end rests in recessus cochlearis, upper end in cupola. Ductus attached on one side to lamina spiralis ossea; on other, to outer wall of bony cochlear canal. cross-section is triangular, two walls diverging from edges of lamina spiralis, and third, corresponding to part of cochlear wall, comprised between insertions of the other two. Lower wall, turned toward scala tympani, called tympanal; upper, towards scala vestibuli, called vestibular. On border of lamina spiralis ossea is a soft structure-limbus laminæ spiraliswhich lengthens lamina toward ductus, and is

developed from periosteum of former. Vestibular wall of ductus passes off from upper surface of lamina ossea at inner attachment of limbus, so that latter is included in ductus. Limbus has two lips, an upper, labium vestibulare, and a lower, labium tympanicum. Furrow between them called sulcus spiralis internus. Upper lip projects like a roof over sulcus, and its edge is divided by furrows into oblong sections, which on front view resemble anterior surface of incisor teeth, and are called audi-Furrows filled with rounded torv teeth. (epithelial?) cells, continuous with layer covering memb, vestibularis. Tympanic lip forms floor of sulcus and has two layers which unite sharp border, continuous with memb. basilaris. Membrana vestibularis, or Reissner's membrane, forming vestibular wall of ductus, runs from edge of lamina spiralis ossea to. outer wall of cochlea. Consists of vascular. connective-tissue basis, covered by endothelium on vestibular side and by epithelium on tympanic side. Membrana basilaris [Gr. Baris, base, forming tyinpanic wall of ductus. is continuation of labium tympanicum, and increases in width from base to cochlea, as lamina spiralis decreases. Divided into two zones, an inner, habenula tecta [Lat. habenula, a little thong, and tego, to cover, and an outer, zona pectinata [Lat. pectinatus, comb-like]. Essential layer is structureless membrane. This is thickest at outer zone,

and is there covered, on tympanal surface, with knobby elevations. Embedded in basis substance is a small vein, vas spirale, anastomosing through radial branches with vessels of lamina spiralis ossea. On vestibular surface is a layer of very fine radiating fibres. which are most prominent in zona pectinata. Sometimes, fine spiral fibres are found on tympanal surface. Corti's organ lies on inner zone. Outer wall of ductus presents internally the memb, propria of the ductus; externally, the periosteum; and, between, a semilunar cushion of connective tissue. Points of insertion of memb. vestibularis and memb. basilaris are prominent, the former called angulus vestibularis, the latter, ligamentum spirale. A part of the memb. propria just above ligamentum spirale is very vascular and called stria vascularis. At lower limit of stria is an elevation, ligamentum spirale accessorium, containing a vessel, vas prominens. Space between this and insertion of memb. basilaris is called sulcus spiralis externus.

Cavity of ductus cochlearis is divided into two parts by a membrane, Corti's membrane or membrana tectoria, [Lat. tectorius, covering,] which runs parallel to memb. basilaris from labium vestibulare to outer wall of cochlea. Latter insertion is about midway between memb. basilaris and stria vascularis. Upper space is filled with endolymph. Lower contains terminal auditory apparatus. Tectorias

memb. very delicate but firm. Divided into three zones: Inner one structureless, pierced by numerous openings, and covers labium vestibulare. Middle one densest, and consists of several fine layers of parallel fibres. Outer one consists of a very fine and friable network. Henle thinks membrane is firmly fastened, so that it cannot press closely upon parts beneath. According to Waldeyer, membrane ends near outer wall by thin, free margin, and rests directly on Corti's organ.

Terminal auditory apparatus (Henle) comprises the structures in the lower chamber of the ductus cochlearis. The auditory rods, pillars or teeth of Corti [Corti, Italy, 19th cent.] are arranged in regular order, somewhat like the keys of a piano. Shaped like Roman S. with slender cylindrical bodies and broad ends, containing granular protoplasm. Two rows, an inner (that nearest lamina spiralis) and an outer. Rods of each row rest by one end, or pedestal, on memb. basilaris. thence rise quite abruptly, and unite with each other by their other ends, or heads, forming an arched roof over inner zone of memb. basilaris, base of arch being about 230 in. broad. Inner rods about 35000 in. broad. Outer rods about 25000 in. diameter, longer than inner, and placed further apart, averaging 7 or 8 to 12 of the latter. Pedestals of inner row lie just outside the perforations in memb, basilaris and the fine ends of the

.

nerve bundles. Tissue of rods is hard as cartilage (Henle). To heads of rods are fastened plate-like processes—the head-plates. Inner rods have two-one on inner and one on outer surface-enclosing a smooth concavity between them, in which heads of outer rods rest, one of latter articulating with two or more of former. Plate on head of each outer rod projects from outer surface, like a phalanx, beyond the joint. Estimated number of pillars: inner, 6,000, outer, 4,500. A perforated membrane, the lamina reticularis [Lat. rete, a net] arises from articulation of rods, and stretches, parallel to memb. basilaris, to outer wall of cochlea. Formed of network of fine hyaline threads, with oblong and round meshes arranged in rows. though delicate, is quite firm.

The cells found in ductus cochlearis—auditory cells—are nucleated, round, and cylindrical. A layer of them covers sulcus spiralis, Reissner's memb., and outer wall of ductus. Upon inner pillars lies a single row of conical cells with large nuclei. They send processes into row of small cells lying next them toward sulcus—the granular layer. The ends turned toward heads of rods bear tufts of stiff, immovable cilia. These cells called inner haircells (inner roof-cells of Henle). Number computed at 3,300. On outer rods lie 3 or 4 rows of double nucleated cells connected by slender processes to memb. basilaris and memb.

reticularis, and bearing also tufts of c Called outer hair-cells (outer roof-cells Henle). Number computed at 18,000. (of cells are received by the corresponding r of openings in the lamina reticularis. He describes another layer of cells lying the memb. basilaris beneath the rods as flacells. He considers the cells as epithelia ganglionic. Waldeyer regards the cells, also the rods of Corti, as epithelial structu

Auditory nerve or portio mollis [Lat. soft part of 7th nerve arises by two root medulla oblongata. One ganglionic nuc of origin is in floor of 4th ventricle. The o is in crus cerebelli ad medullam (Stieda). roots are connected with the gray substa of the cerebellum, with the flocculus, and gray matter at border of calamus scripto (Gray). Nerve winds around restiform be from which it takes fibres, thence forw across post. border of crus, in company portio dura or facial nerve. The two ner then pass into the meatus auditorius interi where some minute filaments connect tl together. At bottom of meatus, facial ne enters Fallopian canal; auditory divides: two branches, vestibular and cochlear, former of which here presents ganglic swelling - intumescentia ganglionifor Cochlear nerve gives off s Scarpa. branch which, at recessus cochlearis, y

to vestibular end of ductus cochlearis, and through 4th macula cribrosa (p. 193) to partition-wall of utricle and saccule. From trunk of nerve a number of fine branches then arise, which pass directly through tractus foraminosus (p. 206) to lamina spiralis of lower wall of cochlea. Remainder of nerve enters modiolus, in which it breaks up into fine anastomotic divisions. Bipolar ganglion-cells are connected with the fibres. Bundles traverse ganglion spiralis in canalis ganglionaris (p. 195) at beginning of lamina spiralis, and finally pass into latter. Fibres radiate with numerous anastomoses between the two plates of the lamina spiralis throughout all its turns. Vestibular branch after its gangliose expansion divides into three branches: (1.) Superior, passes through macula cribrosa superior (p. 193) and ends by three branches to utricle and ampulla of sup, vertical and horizontal semicircular canals. (2.) Middle, passes through macula cribrosa media to saccule. (3.) Inferior, passes through bony canal of its own to ampulla of inf. vertical semicircular canal.

The terminal nerve-fibres pass from the lamina spiralis, through fine holes in labium tympanicum and in memb. vestibularis, into ductus cochlearis. They run radiate course, passing through granular layer, whence some end in inner hair-cells, and others run between rods of Corti, and across tunnel formed by

them, to end in outer hair-cells. Other nerve (?) fibres run spiral course among granular layer and inner and outer hair-cells, but exact origin and ending is unsettled.

Blood-supply of labyrinth comes through auditiva interna artery, a branch from basilar of vertebral. In meatus internus the artery divides into vestibular and cochlear branches. Former passes in fine twigs through post. wall of vestibule to soft structures of latter and of semicircular canals. Latter sends fine branches through tractus foraminosus into modiolus, and thence between layers of lamina spiralis. Some small branches are said to go to labyrinth from stylo-mastoid.

THE INTERNAL AUDITORY CANAL, or meatus auditorius internus [Lat. equiv], begins at about the centre of the petrous portion of the temporal bone by a large orifice with smooth, rounded edges, and runs directly outward about \(\frac{1}{2}\) in to end in a blind fossa. Floor of fossa marked by four depressions, which are perforated by fine foramina through which the fibres of the auditory nerve enter the labyrinth. Three of them correspond to the maculæ cribrosæ (p. 193). The fourth lies opposite the base of the cochlea, is spiral-shaped with spirally arranged foramina, and is called the tractus spiralis foraminosus.

## CHAPTER II.

# EXAMINATION AND DIAGNOSIS OF AURAL DISEASE.

TESTS OF HEARING:—A watch is held opposite the ear, and the farthest distance at which its tick is heard is noted. It is usual to make this distance the numerator of a fraction, whose denominator is the distance at which the tick is heard by a normal ear. The letters H. D. are used for designating hearing distance; R. E. for right ear, and L. E. for left ear. For example, if a normal ear hears the watch at 40 in., and the right ear of the patient hears it at only 10 in., we write H. D. R. E. =  $\frac{10}{40}$ . If the watch is heard only when it touches the auricle, H. D. = contact If when pressed against the ear, H. D. =  $\frac{\text{pressed}}{40}$  or  $\frac{P}{40}$ . If not heard at all, H. D. -. Sometimes the watch is only heard when pressed against the mastoid process, H. D. = mastoid. The clicking noise made be rubbing the edges of the finger-nails t

is sometimes a convenient substitute for th watch-tick.

Another test of hearing-power is the voice Stand behind the patient, and find at wha distance he can hear ordinary or loud con versation. There is often a curious dispre portion between the two tests: a patient wh scarcely hears a watch at all may hear con versation at fifty feet, &c. The voice-test therefore, gives the best idea of the practica

hearing-power present.

The tuning-fork is used to determin whether a lesion of the auditory nerve exist It is made to vibrate, and its handle is the placed upon patient's forehead or (preferably his closed teeth. If disease is confined t external or middle ear, sound of fork is hear most distinctly in ear most affected. If nerv is affected, fork is heard better in better ear In mixed cases test is less useful. A source of error in using this test is that patients are ar to say they hear the fork better in the bette ear because they think they ought to do so Large forks of the note C are those generall used. (See p. 252)

Condition of nasal and pharyngeal mucou membrane should always be examined. Rhi noscopy and laryngoscopy are of great as sistance.

Present condition of general health an inquiries as to past illnesses are very impor tant.

THE AURICLE is easily examined.

For examining EXT. AUDITORY CANAL and membrana tympani an aural speculum and mirror are necessary. End of speculum is inserted about 1 in. into meatus, and held between thumb and forefinger of one hand; at the same time the upper edge of the auricle is held between same forefinger and the middle finger. In this way the auricle can be pulled upward and backward, which obliterates curves of canal, and allows clear view to bottom of it. Parts are illuminated by the otoscope-a round, concave mirror about 3 in. diameter, with central perforation-which is held close before the observer's eye at a distance of 6-10 in. from the patient. Either daylight or artificial light may be used; former is simpler, and generally answers every purpose. When both hands are required for examination or for making applications, mirror is held on forehead by an elastic band passing around head.

THE EUSTACHIAN CATHETER AND POLITZER'S METHOD are used to introduce air into the middle ear through the Eustachian tube. Their diagnostic use is to show whether tubes are pervious, and whether predominating elements of disease are such (catarrhal) as can be relieved by inflation. If so, patient will feel the puff of air enter his ear, drumhead will probably be pushed outward and

signal, it will usually cry during the operation, and that opens the tube just as well.

VALSALVA'S METHOD, or the VALSALVIAN EXPERIMENT [Valsalva, Italy, 17th cent.] consists in taking a deep inspiration, and then forcing the air outward so as to distend the cheeks and inflate the ears, while the mouth and nostrils are kept tightly closed. Its frequent use congests the ears and relaxes the drum-head; and, being inferior to the other methods, it should not be advised.

Some pass slender *bougies* through the catheter to examine for strictures of the tube. Their use is dangerous and requires great caution. (See p. 254)

## THERAPEUTICS AND SURGERY OF THE EAR.

Syringing the Ear: There are needed a syringe (holding 4 to 6 oz.) with a bulbous nozzle, a bowl to hold the water, and a lighter one (such as a finger-bowl) to catch it. Patient, being seated, holds the small bowl under the auricle and pressed firmly against the cheek, to prevent the water from running down his neck. Operator should straighten canal by pulling auricle up and back with one hand, and, placing nozzle of syringe well into meatus, should gently force the stream down to the

bottom of it. As a rule, only simple water should be used, and as warm as can be borne

comfortably.

THE AURAL DOUCHE: Is used where a steady flow of warm water is required,—as in acute inflammations. Douche consists of a cup to hold the water, with a piece of rubber tubing attached. Cup is placed above the head, so that the water runs through the tube and into the ear from its own weight. Force of stream can be regulated by height of cup, and should be very gentle. Ordinary fountain syringe makes a very convenient douche.

If all syringing causes pain or vertigo, water may be dropped into the ear from a sponge: or, a camel's-hair brush may be used

to clean the ear.

THE COTTON-HOLDER:—Is simply a slender steel probe, around whose end a little cotton can be wound. Used to cleanse and dry the deep parts of ear and to make applications to them. Should only be used under good illumination from otoscope. Cotton

should be very soft and clean.

LEECHES: In inflammations of external auditory canal or middle ear, should be applied at base of tragus, on front wall of canal, or on mastoid process, for reason that at these points vessels which supply diseased parts are most conveniently and surely reached. Cotton should be placed in meatus to keep leech from crawling in-

By using leech-glass and scratching skin to draw a little blood, the leech can be applied to the exact spot desired. After-bleeding should be encouraged for an hour or more, after which it can be checked with styptic-cotton, &c.

BLISTERS BEHIND THE EAR: Usually of very little use in chronic inflammation; and in acute attacks, where prompt measures are needed, they merely add to patient's discom-

fort.

POULTICES: Injurious as a rule. In acute inflammations, tend to make tissue ædematous and to favor its breaking down. If ever needed to quiet pain, should be of conical shape, small enough to be pushed into meatus, and only applied for a short time.

MEDICATED SOLUTIONS to be dropped into the ear should always be warmed. Easily done by holding them in spoon or test-tube over a

flame.

INFLATION OF MIDDLE EAR: (Vide p. 211.)

PARACENTESIS OF MEMBRANA TYMPA-NI [Riolanus, Paris, 1650]: Often performed in acute inflammation of middle ear. As large a speculum as possible is used; and, while ear is well illuminated by forehead-mirror, paracentesis-needle is passed along floor of meatus until drum-head is reached. Membrane can then be pierced at any point desired. After incision it is usual to inflate ear by Politzer's or Valsalvian method. This Opens the wound and tends to force out any

matter which may lie in the tympanic cavity. Paracentesis is also performed for chronic cases of non-suppurative inflammation, its principal use being to facilitate medication of middle ear.

TENOTOMY OF TENSOR TYMPANI [Weber-Liel, Berlin, 19th cent.] at its insertion into the malleus is sometimes done, where muscle's contraction appears to cause injurious pressure on fenestra ovalis. Tenotome is passed through ant. segment of drum-head, a little below short process of malleus, and point pushed around behind malleus so as to reach tendon.

DIVISION OF ADHESIONS between memb. tympani and promontory may be successfully done by a knife devised for the purpose.

INSERTION OF AN EYELET INTO MEMB. TYMPANI [Politzer], to preserve a permanent opening, is done. Operation difficult and not free from danger. [The three latter operations are performed in desperate chronic cases, and results thus far have been chiefly negative.]

TREPHINING OF MASTOID PROCESS:-

[Petit, France, 1750] (Vide p. 239.)

HEARING-TRUMPETS:—Thus far there are no aids for conducting sound to the ears of persons incurably deaf more efficient than the ordinary metallic or flexible tubes known as hearing-trumpets. (See p. 25%).

## CHAPTER III.

#### DISEASES OF THE EAR.

#### AURICLE.

- 1. Injuries.
- 2. Eczema.
- 3. Tumors.
- 4. Malignant Disease.
- 5. Malformations.

INJURIES: are of various kinds, and require same treatment as in other parts.

ECZEMA: is quite common, and generally associated with eczema of external auditory canal (vide p. 222). Presents same appearances as elsewhere and requires same treatment. (See p. 255.)

TUMORS:—comprise (a) Fibro-cartilaginous; simple hypertrophies; most frequent
among negroes; result often from irritation of
piercing ears for earrings, and where brass earrings are worn; may be removed by V-shaped
incision, edges of which are afterwards united
by sutures. (b) Sebaceous; may be enucleated. (c) Ercctile; best treated by galvanocaustic. (d) Othamatoma or vascular tumor;
idiopathic and traumatic. In former, ear
becomes red, swollen and hot, and then effusion
blood occurs, mostly in concha, obliterating

folds of auricle, and causing painful, roundish tumor, of variable size, in which fluctuation may be found; effusion may be absorbed or rupture or suppurate; etiology supposed to be cerebral congestion and centripetal irritation from the emotions; most common among the insane; some advise non-interference, others opening and evacuating sac and use of pressure-bandage; after recovery great deformity is apt to result. Traumatic form is simple extravasation from vessels ruptured by violence, and is not apt to leave deformity.

MALIGNANT DISEASE is very rare; ampu-

tation of auricle is the proper remedy.

MALFORMATIONS: may be congenital or result from ill treatment (such as allowing hat to press against auricle, etc.), or from disease. Auricle may be congenitally absent, or rudimentary, generally with same defect of deeper parts. Supernumerary auricles have been observed.

DEPOSITS OF URATE OF SODA are often seen on the auricles of gouty subjects, especially on the helix: sometimes cause consid-

erable pain.

DIFFUSE INFLAMMATION and ABSCESSES of the auricle, from whatever cause, require careful attention, as they tend to produce great deformity.

### EXTERNAL AUDITORY CANAL

- 1. Foreign Bodies.
- 2. Inspissated Cerumen.
- 3. Diffuse Inflammation.
- 4. Circumscribed Inflammation.
- 5. Eczema.
- 6. Vegetable Fungous Growths.
- 7. Polypi.
- 8. Syphilitic Ulcers and Condylomata.
- 9. Exostoses and Hyperostoses.

FOREIGN BODIES: Include insects and their larvæ, and such articles as beads, buttons, peas, beans, etc., which are thrust into ear, especially by children. Insects sometimes fly into ear; cause agonizing pain. Syringing with warm water usually brings them out at once. They are readily attracted by the odor of a suppurating ear to deposit their larvæ upon the pus within it; larvæ may cause pain, or only discomfort, by their wriggling motions. Examination of an ear so affected shows small, white, worm-like animals moving rapidly about; they are provided with hooks by which they cling to the tissue. Cannot generally be dislodged by syringing, unless some parasiticide has first been used. Labarraque's sol., chloroform vapor, carbolic acid sol., etc., have been used for this purpose; sometimes forceps are necessary. Beads, buttons, etc., are chiefly dangerous

through indiscreet efforts to remove them; through such attempts, the ear, and even the life of the patient has been destroyed. Beans, peas, etc., are troublesome, because they swell after being in canal for some time. In treating these cases, first thing to do is to examine ear with otoscope; never try to remove a foreign body which you cannot see. In ordinary cases, simple syringing will suffice. If body is impacted, and there is inflammation and swelling about it, better to wait until latter subside. If instruments become necessary, patient should be etherized and body dislodged, if possible, by forceps or probe, and then removed by syringe. Value of patient and gentle manipulation cannot be overrated. If foreign body is causing no bad results, there need be no haste about its removal. If instruments really become necessary, they should only be used by a practised hand. Foreign bodies sometimes penetrate into the middle ear, but require no different treatment to that given above.

INSPISSATED CERUMEN, or hardened wax, is quite often found in auditory canal. In majority of cases, probably secondary to some other affection of ear, and should be so considered when complete relief of symptoms does not follow its removal. Wax is not removed by motions of jaw, as it normally is, but collects in canal, its watery parts evaporate, and a brown or black mass is left, some-

times as hard as stone. Symptoms are deafness, tinnitus [Lat. for ringing], sense of fullness, vertigo, and pain-two latter being rather infrequent; deafness usually sudden, because it does not occur until impaction takes place, although there may be a great deal of wax present; impaction may result from any sudden jolt, etc. Wax easily seen with otoscope as dark mass, filling canal Simple syringing with warm water best method of removing wax, and usually sufficient. Sometimes, where wax is very hard, a solvent, such as sol. sodæ bicarb., (grs. x. to \( \frac{7}{3} \) i.) may be dropped into the ear several times for a day before the syringing is begun. Several sittings may be needed to remove the wax, and they are preferable to doing too much at once. Probe may be necessary to loosen mass and break up its hardened surface, so that syringing may be effectual. Instruments should be avoided. however, if possible. All the wax should be removed, as even a small piece left upon drum head will keep up the unpleasant symptoms. Where hearing is normal after removing wax, a little cotton should be kept in ear for a few days, otherwise sounds will be unpleasantly acute, and shock of them may injure the car. Where hearing is not normal, after the wax has been removed, inflation may improve it. (See p. 257, 258.)

DIFFUSE INFLAMMATION is quite rare.

Caused by local irritation, such as ear-picks, dropping of oils into ear, etc., and, rarely, by exposure to cold. Symptoms are itching, followed by pain, sense of fulness, and, perhaps, some deafness. Canal and memb. tympani red and swollen, and epidermis and integument may suppurate. Where skin is closely adherent to bone, pain is intense and disease is essentially a periostitis. ment in acute stage comprises leeches, incisions, and warm douche; and, if these fail, poultices. If suppuration is established, ear should be thoroughly cleansed every day by syringe, and astringents applied. Solution of alum or zinc (gr. 1-4 to 3 i.) may be dropped into ear by patient, after syringing. Surgeon should cleanse the ear himself 3-4 times a week, and make some appropriate application to the affected part.

CIRCUMSCRIBED INFLAMMATION or FURUNCLE, is a symptom of a wrong state of the system. Apt to occur in anæmic persons, and to be recurrent. Very painful, and may cause deafness by filling up canal. Does not usually cause tinnitus. Proper treatment is to make an incision as soon as possible, whether pus has formed or not, and then to use warm douche freely. Probe is useful to find the most tender point, where furuncle is not very marked. Incision is best made with a sharppointed bistoury, and should be a deep and free one. Leeches are not of much service.

Small cotton plug, saturated with gl sometimes useful to quiet pain.

ECZEMA: generally associated with of auricle. Swelling of canal cau ness and tinnitus, with deafness. Di rarely brought to notice until it has chronic. In treatment, first require thorough removal of exuded matter day, and this is best done by the surge self. Warm douche and cotton-holder means. After cleansing, an astringen be applied, a liquid one being best, a not clog up the canal. Frequent use warm douche by the patient is useful fing the canal clear and to allay pritching.

VEGETABLE FUNGI; sometimes ated in auditory canal, and cause gravate inflammations of the part. commonly secondary to eczema. Sy of otitis parasitica are tinnitus, deafness, dull pain, vertigo, whitish o ish flakes adhering to walls of canal as surface membrana tympani, and bloc passage. Latter require forceps for moval, and tissue beneath them is fo and tender. Growth may reappear i hours. Varieties of parasites are:

1. Aspergillus.

flavus.
glaucus.
nigricans.

- 2. Penicillium glaucum.
- 3. Graphium penicilloides.
- 4. Tricothecium roseum.

They can only be seen by the microscope. Treatment consists in keeping canal free from fungus and subduing inflammation. Many parasiticides are recommended, but the warm douche thoroughly used is as good as any. Inflammation of canal is treated as usual.

POLYPI: are result of a prolonged or violent acute suppuration, or one that has been augmented by poultices so that integument has been destroyed by ulcerative process. Usually associated with polypi of middle ear and require same treatment (vide p. 236.)

SYPHILITIC ULCERS and CONDYLOMATA; very rare. Require local cleanliness and the

proper internal remedies for syphilis.

Exostoses and Hyperostoses, or bony growths. Sometimes occur in osseous part of auditory canal. Most frequently come from chronic suppuration of the middle ear, extending its irritation to the canal, and will therefore be considered under that section (vide p. 237). May be congenital or occur in some special diathesis. If canal is occluded by growth, an operation for opening a passage through it (such as that of boring a hole with a rat-tail file or a dentist's drill) must be performed.

#### MIDDLE EAR.

INTURIES OF MEMBRANA TYMPANI: Subject to injuries from concussions, from effects of condensed air, from foreign bodies, instruments, etc. Membrane has been ruptured from artillery explosions; from exposure to condensed air, as in caissons used in building bridge-piers; from blows upon side of head; from waves striking side of head in seabathing; from violent vomiting, coughing, blowing of nose; from hair-pins, blades of straw, etc., thrust into ear; from use of instruments, etc. Where there is disease of ear, and collection of mucus in tympanum and Eustachian tube, drum-head is much more liable to rupture from all the nontraumatic causes than where parts are healthy. Rupture of drum-head in suppuration of the middle ear belongs under that section. To determine the nature of a rupture it should be seen soon, before suppuration has had a chance to occur around it. Traumatic ruptures are apt to heal promptly, without suppuration, and to leave hearing intact. Those from concussion are serious, as deeper parts are generally injured at the same time. Treatment: Above all, ear should not be disturbed by syringing or otherwise immediately after the injury. inflammation and suppuration appear, they should be treated as in acute inflammation of the middle ear. Meanwhile, the ear should be protected by a bit of cotton placed in meatus, and patient kept under careful but

not meddlesome observation.

MYRINGITIS [Lat. myringa] or INFLAMMA-FION OF DRUM-HEAD, is only part of an inflammation of adjacent regions. The anacomical structure of a membrane which has no independent nutrition, which has but one ayer of tissue peculiar to itself (and that in its centre), but which is a direct continuation of neighboring parts, rather precludes the idea of its being primarily diseased.

FRACTURE OF THE HANDLE OF THE MAL-LEUS is very rare, only three or four cases naving been reported. The diagnosis in these cases was based upon the peculiar, irregular

appearance of the bone.

The principal affections of the middle ear

1. Acute Catarrhal Inflammation.

2. Subacute Catarrhal Inflammation.

3. Chronic Non-Suppurative Inflammation, (a.) Catarrhal.

(b.) Proliferous.

- 4. Acute Suppurative Inflammation. 5. Chronic Suppurative Inflammation.
- 6. Consequences of Chronic Suppuration.
  - (a.) Polypi.

(b.) Exostoses.

(c.) Mastoid disease.

(d.) Caries and Necrosis of temporal bone.

(e.) Cerebral abscess.

(f.) Pyæmia.

(g.) Paralysis.

ACUTE CATARRH of the middle ear is quite common. Has many causes, such as exposure to cold and wet; allowing cold water to run into ear; "colds in the head;" constitutional diseases, such as scarlet-fever, measles, small-pox, pneumonia, syphilis; use of "nasal douche," etc. Danger from latter instrument probably due to entrance of some of the water through the Eustachian tube into tympanum. Acute catarrh generally starts from faucial end of Eustachian tube. but may sometimes extend from ext. auditory canal. Symptoms are pain; sense of fulness; tinnitus; impairment of hearing; injection, swelling, and bulging outward of memb. tympani; catarrh of pharvnx and Eustachian tube; fever, and, rarely, delirium.

The pain is usually intense. The familiar "earache" is identical with acute catarrh. In children too young to speak, it may be difficult to locate the pain. Pressure against the car to see if the child winces, and dropping warm water (or even breathing) into the ear to see if it quiets the pain, are useful diagnostic tests. Sensations of fulness may precede pain or follow it. Tinnitus generally assumes form of a beating or puffing in the ear, and is dis-

tressing. Deafness may not be marked in stage of pain; indeed, hearing sometimes seems more acute than normal. Redness of memb. tympani may be confined to periphery and along malleus-handle, or be intense over whole membrane, effacing all its normal appearances. Bulging outward of the membrane may often be seen after the first 48 hours of the attack, generally in posterior part, and in Shrapnell's membrane. Spontaneous perforation is then apt to follow. Fever, and

even delirium, are sometimes present.

Treatment should be antiphlogistic and prompt. First remedy in efficiency is local blood-letting by one to four leeches to the tragus (p. 213). Next is warm water poured into the ear by the douche so as to give it a continuous bath. Douche may be used for several minutes every half-hour. Breathing into the ear, steaming it, and blowing in of tobaccosmoke are sometimes useful to quiet the pain. Poultices should only be used when other measures fail, as they are dangerous to the integrity of the drum-head. Dropping of oils, molasses, etc., into the ear is useless, and only clogs up the canal. A little laudanum may be added to the warm water, if desired, and opium may be given internally. If perforation of memb. tympani is threatened, a paracentesis should be performed; or it may be done to relieve the pain where other means have failed, even when there is no bulging (p. 214). If the mastoid region becomes involved, an incision should be promptly made down to the bone (p. 238). Inflation is advisable when acute symptoms subside, to blow out secretion and prevent adhesions.

Such prompt treatment generally results in a perfect cure, saving the patient from chronic otitis and its bad consequences. If suppuration occurs, it is usually tractable (p. 233).

Several cases of acute catarrh have occurred in which the course was very rapid, ending in perforation without suppuration, but with abundant hemorrhage through the drum-head. In other cases of acute catarrh, where a paracentesis has been done, only blood has escaped from the tympanum. The name given to such cases is otitis media hemorrhagica. [Hemorrhage into the middle ear may also occur from atheromatous vessels, as in kidney disease.] (See p. 255.)

SUBACUTE CATARRH:—Common in children and young persons. Distinguished from acute catarrh chiefly by its milder course and by the absence of severe pain. Patient is subject to seasons of marked deafness, fulness and tinnitus; memb. tympani may be congested or not, and pharynx is catarrhal. Pathological changes are probably plugging of the Eustachian tube and tympanum by mucus, without structural changes. Treatment: It will generally be found that patient is badly managed, and needs proper hygienic.

care; such as regulation of diet, attention to skin, proper exercise, etc. Tonics and attention to pharynx are important. The use of the catheter (except in children) and Politzer's method generally restore the hearing—in some cases almost immediately.

The non-suppurative inflammations are described separately for convenience, but it must be remembered that in practice the line of separation between them is not always well marked:—

CHRONIC CATARRH OF THE MIDDLE EAR: Forms a large proportion of the cases presenting themselves for treatment. It is either a consequence of acute catarrhs, or supervenes upon chronic catarrh of the throat, especially in constitutions enfeebled by disease or bad hygiene. Patient has the usual symptoms of chronic naso-pharyngeal catarrh. In addition, he has occasional sounds in his ear like crackling of air-bubbles; sense of fulness; tinnitus; deafness; sometimes vertigo. Tinnitus is very annoying, causes great depression, sometimes resulting in suicide. Noises variously described as buzzing of insects, rushing of water, ringing of bells, etc., etc. There are also changes in the memb. tympani, and imperfect action and changes in structure of Eustachian Appearances of drum-head are valuable in connection with other signs, but not always diagnostic, as many of them may also handle; by diminution, of the light spot; and by appearance of the mem describe. There may be a lustre of the membrane, calcareous deposits in it. its natural mobility from preternaturally mobile. while patient performs Valor by Siegle's otoscope. and Eustachian tube usuall presents familiar appear catarrh. Often it is stude elevations, constituting phy Rhinoscope shows simila mouth of Eustachian tube able as a sound for determ of the nasal mucous mem,

to take cold will assist in relieving chronic aural catarrh. Attention to skin, daily sponge bathing and frictions, Turkish baths, etc., are very useful. Treatment of pharynx and nose very necessary. Injections of the nasopharyngeal space by a long syringe made for the purpose, are useful to dislodge collections of matter, if for nothing else. Various solutions are used in the syringe, of which those of salt and chlorate of potash are most common. Nasal douche dangerous, as it has often caused acute inflammation of middle ear, even when all precautions had been observed in its use. Better to wash out nostrils with Davidson's syringe by gentle and intermittent current. Same solutions are used as in post nares syringe. The applications to be made to the nasal and pharyngeal mucous membrane will, of course, vary with different practitioners. A gargle is a matter of individual choice. Saturated sol. chlorate of potash as good as any for ordinary purposes. Tröltsch's method of gargling is useful as gymnastic exercise for muscles of tube, aside from its effect on mucous membrane :- The gargle is held in back part of mouth, the head thrown well back, and the nostrils closed with the fingers; swallowing motions are then performed without actually swallowing the solution. Eustachian catheter is used for treating tube and tympanic cavity. Simple air blown through it is most universally useful. Steam,

#### 232 PROLIFEROUS INFLAMMATION.

weak solutions iodine, nitrate silver, zinc., etc., are also used. Inflation of middle ear by Politzer's method should be done every day or two. Most effectual when used after catheter. Whenever attacks of congestion or pain occur in course of disease, leeches, warm douche, etc., should be tried (vide p. 227).

CHRONIC PROLIFEROUS INFLAMMATION: -In this form, the symptoms, except loss of hearing and tinnitus, are less positive than in catarrhal form. There is no pharyngitis, and patient's history does not include infantile earaches, coryza, frequent colds, etc. It is found that disease has begun and advanced insidiously, that it has got under full headway and essentially impaired hearing before patient has noticed it. There may be no sign of catarrh, no closure of Eustachian tubes, nothing pointing to an excess of secretion in pharynx, tubes or tympanum, but rather to an opposite state of affairs. There are apt to be adhesions in tympanic cavity with a sunken and immovable drum-head. no cause can be discovered. Sometimes there has been a catarrhal inflammation which has long since passed away. In certain cases, the disease seems to have some connection with pregnancy. Pathological changes found include: adhesions in tympanic cavity, anchylosis of ossicles, atrophy and fatty degeneration of tensor tympani, obstruction of tube

and tympanum by dense fibrous tissue, hy-

Treatment: like that of catarrhal form, excepting that pharynx does not usually need attention.

In many of the cases of non-suppurative inflammation, a cure is out of the question, and the best that can be hoped for is to alleviate the condition or keep it stationary. Hygienic treatment should be kept up during patient's life. Local treatment, if it does any good, may be given for from 1-2 months, twice a year. Some cases progress in spite of every remedy. For inveterate cases which resist all ordinary treatment, such operations as exhaustion of air from drumhead, maintaining permanent opening in it, and division of tensor tympani are sometimes performed. They are only to be undertaken by a skilled surgeon, and indications for them will be found in larger text-books. As a rule, they are not productive of much benefit.

ACUTE SUPPURATION OF MIDDLE EAR: usually a direct result of acute catarrh, and preceded by its violent and painful symptoms (p. 226). In many cases, however, latter process is unobserved and discharge of pus is first thing noticed. In cases occurring from scarlet fever, measles, etc., catarrhal stage apt to be overlooked because of grave symptoms of the general disease. Causes are same as those of acute catarrh, exposure to cold being most

common one. When drum-head bursts, pain usually subsides. Sometimes pus escapes through Eustachian tube leaving drumhead sound. Occasionally, suppuration extends to brain through thin tympanic wall, or produces pyæmia by entering jugular vein.

Treatment: In early stages, leeches; and if membrane seems about to break, paracentesis should be done in most bulging part. (p. 214). If mastoid is red, swollen and tender, an incision should be promptly made down to bone. (p. 238). Ear should be douched frequently with warm water. If membrane has already ruptured, ear should be cleansed of pus at least twice a day by syringing, after which a weak astringent, such as sol. zinci sulph. (gr. ii. to 3 i.) may be dropped in (p.214). This may be done by patient himself. Ear should be cleaned and astringent applied by surgeon every other day, if possible. Politzer's method may be used gently every day or so, to blow secretions from tympanum and prevent formation of adhesions. Under this plan, case usually progresses well, membrane heals and good hearing is restored.

CHRONIC SUPPURATION OF THE MIDDLE EAR: commonly called otorrhæa, or "running from the ear." Often mistaken for chronic suppuration of ext. auditory canal, which is very rare—a mistake which need never occur if otoscope is used. Chief symptom is puru

lent discharge. This may be profuse or scanty, or only periodic. In latter case, mass of dried pus may be found in canal and tympanum when ear is examined. Drum-head may be swept away and ossicles also; or there may be a rim of it left with one or more of the ossicles in place or dislocated; or there may be one or more cleanly-cut holes in it, with ossicles in position. Sometimes, perforation is very small and only detected by having air blown through it from Eustachian tube, when the "perforation-whistle" will be heard, or a drop of pus blown out through it. Pulsation at bottom of canal is suspicious but not pathognomonic of perforation. Depends on layer of fluid in contact with beating bloodvessel. Pharynx and Eustachian tube usually in catarrhal state, and general health below normal. Degree of deafness variable, depending as it does on many factors. Course of disease tedious and requires very patient treatment. In some cases, suppuration never is permanently subdued. Anatomical relations of tympanic cavity show the danger of allowing disease to proceed unchecked. (p. 236). (See p. 255.)

Treatment:—First requisite is cleanliness. Ear should be syringed once or twice p day. (p.212.) Should be cleaned by surgeon himself as often as he may think best. Politzer's method is an aid in blowing secretions out of tympanic cavity and breaking up adhesions.

After cleansing, some astringent or caustic should be applied. If perforation is small, an astringent solution may be dropped into ear and allowed to remain a few minutes (p. 214). If drum-head is gone, solution may be applied over the exposed surface by a cotton-holder. Various solutions are used :-- Zinci sulph. gr. 1-5 to 3 i.; argenti nitrat. gr. 10-480 to 3 i.; cupri sulph. gr. 1-5 to 3 i.; alum sulph. gr. 1-5 to 3 i., &c. Various powders are also blown into the ear-such as alum, iodoform, bismuth, salicylic acid, &c. Application may be changed now and then with advantage. After irritation and suppuration have subsided, hearing may sometimes be improved by insertion of an artificial drum-head. Latter is only of service where drum-head is partly or wholly destroyed, and where deafness is marked. It must be used carefully, and removed at once if it causes irritation. p. 256.

#### CONSEQUENCES OF CHRONIC SUPPURATION.

Polypi:—usually consist of loose connective tissue, cells, and blood-vessels, and are analogous to the well-known exuberant granulations. Generally spring from tympanic cavity, but sometimes from auditory canal (p. 223). Most common cause is a long-continued suppuration of middle ear. Best method of removing aural polypus is by Wilde's polypussnare or by scissors. Forceps are more dan-

gerous, especially in unskilful hands. The manipulations are performed through a speculum under illumination from the otoscope. Granulations attached by a broad base, which are hard to remove by snare, may be frequently punctured with needle and then touched with nitric acid or some other strong caustic. The removal of a polypus usually improves the hearing. [Malignant growths sometimes occur in ear which assume form of polypi,

and may be mistaken for them.

Exostoses and hyperostoses, or bony growths: -are both congenital and acquired. The congenital ones usually cause no inconvenience and require no treatment. The acquired have an inflammatory origin and most commonly result from chronic suppuration of middle ear. The local irritation causes first a periostitis, and, secondarily, an enlargement of bone. Sometimes occur in connection with a special diathesis, such as the gouty, rheumatic, syphilitic, &c. May grow so large as to block up canal and cause fatal retention of pus. Treatment should be directed to cause. Ear should be kept scrupulously clean, to prevent retention of pus. Iodine may be painted over tumor. If occlusion occurs, a passage must be opened for exit of pus by an operation. The operation of boring a hole through the tumor with a rat-tail file is called Bonnafont's (p. 223).

Mastoid disease :- includes periostitis;

caries and chronic suppuration. Mastoid periostitis often arises in suppuration of middle ear. Is marked by pain, redness, swelling and tenderness of mastoid region. If not relieved may extend to brain through some of the connecting foramina. An incision should be promptly made over mastoid [Wilde's incision], parallel to attachment of auricle and reaching down to the bone. It should not be a mere puncture, but a cut at least threequarters of an inch long. In early stages, pus will not be found, but bleeding and relief of tension from incision will do good. Poultice should be applied and opening maintained by tent for some time. In children, and sometimes in adults, there is a redness and ædematous swelling of mastoid which does not need such a prompt incision, and which may recover without it. It differs from a true periostitis by the absence of the great tenderness of the latter affection.

Caries and suppuration of mastoid process is an extension of the inflammation last described. Bony partitions between the cells become dissolved and break down into a granular detritus. Symptoms do not differ much from those of periostitis, and diagnosis may be difficult. Any persistent, deep-seated pain in mastoid region is suspicious. A fistulous connection with auditory canal sometimes exists. First remedy is incision, like that for periostitis. If fistula is found in bone it should

be enlarged to give exit to pus. If there is no fistula mastoid must be trephined, if there is suspicion of caries or retained pus. The periosteum is first dissected up, and a small trephine worked carefully in a direction inward, forward and upward. Cell-structure is usually reached at depth of \$\frac{1}{6}-\frac{1}{4}\$ inch. Wound should be dressed from bottom with lint and kept open

for some time. (See p. 258.)

Caries and Necrosis of Temporal Bone: may occur from chronic suppuration of middle ear, and maintain the discharge of pus in spite of all efforts to stop it. Spot of diseased bone may be very minute or quite extensive. Use of probe for diagnosis must be very cautious. From relations of tympanic cavity, caries of its walls is very dangerous. In some cases, diseased bone is thrown off and parts heal. Nearly whole petrous bone has been exfoliated in this manner. Fatal hemorrhage has occurred from caries of walls of carotid canal, lateral sinus and jugular vein.

Cerebral Abscess: Suppuration of middle ear is most common, single cause of cerebral abscess—especially where there is not a free exit for pus. Symptoms of extension to brain sometimes insidious. May be a chill or convulsion, nausea and vomiting. Or, increased pain, followed quickly by paralysis, coma, and death. Or death may occur suddenly without being preceded by brain symptoms.

Pyamia or Metastatic Abscesses may occur

#### DISEASE OF INTERNAL EAR.

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from aural disease by entrance of pus into circulation through mastoid veins or lateral sinus. Several such cases have been reported, some of which recovered.

Paralysis of 7th nerve as it passes through tympanic cavity in Fallopian canal may result from suppuration and caries of middle car. May be temporary, from pressure on nerve; or permanent, from destruction of it.

#### INTERNAL EAR.

NERVOUS DEAFNESS is an affection of the auditory nerve or labyrinth, or of both. Primary nervous deafness is the rarest of all aural diseases. Secondary disease of labyrinth, extending from middle ear, is probably quite frequent. Primary disease may result from injury, such as fracture of petrous bone: from hemorrhage or serous effusion into labyrinth through diseased blood-vessels; from inflammation of membranous labyrinth (?); from concussions of nerve, as in boiler-shops, cannonading, etc.; from large doses of quinine, acting by congesting nerve (?); from meningitis and cerebro-spinal meningitis, by direct extension of inflammation; from syphilis, perhaps by periostitis and gummata of labyrinth; from fever and the exanthemata; from aneurism of basilar artery, cere bral tumors, etc.

Symptoms: only pathognomonic one is absolute deafness. Staggering gait or loss of equilibrium is also a symptom of nerve-deafness. Many cases in which latter symptom was marked have been wrongly classified as Menière's disease, after Dr. P. Mènière, of Paris, who recorded several such cases. Only autopsy he made showed disease confined to semicircular canals, but the case was not a fair type of the others. Another point is that nervedeafness usually occurs suddenly. Such symptoms as partial deafness, tinnitus, vertigo, nausea and vomiting, occur also in affections of the middle ear, -but nausea and vomiting are rare unless labyrinth is involved. In disease of nerve, tuning-fork is heard better in better ear (p. 208), and stopping meatus with finger does not intensify sound of fork, as it does if disease is confined to middle ear. There are no appearances of membrana tympani that give evidence of disease of internal ear. Disease of cochlea produces deafness to certain tones. This symptom, however, as well as "double hearing" (hearing last notes repeated or echoed) may be secondary to disease of middle ear causing pressure on labyrinth. (See p. 256.)

Treatment: each case must be treated according to its symptoms. In acute inflammatory disease, cold applications to head, leeches, counter-irritation and avoidance of quinine would be indicated. Effusions due

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fractions. For example, a lens of 24 inches focus is only is as strong as the unit of measure, and must be designated by it; a lens of 10 inch focus is 1, etc. In making calculations we have always to add or subtract fractions, which is inconvenient. In the metric system, the unit is a weak lens, of one metre focal length. called a dioptric (D). It is about equal to the 16 lens of the old system. The stronger lenses are multiples of the unit. Calculations are easily made, as we deal only with whole numbers. For example, a lens twice as strong as the unit is one of two dioptrics, 2 D; one three times as strong is 3 D; one half as strong is .50 D, etc. Ophthalmoscopes and cases of trial-glasses are now numbered according to both systems.

Page 112. Keratitis bullosa is a rare form of corneal inflammation whose cause is obscure. It is characterized by a localized infiltration of the deeper layers of the cornea, over which a transparent vesicle forms and breaks, leaving a superficial ulcer. After the breaking of the vesicle. repair is rapid. The disease is attended by acute pain and great spasm of the lids. Sometimes the intra-ocular pressure is increased. There is but slight tendency to suppuration or rupture of the cornea, or to invasion of neighboring tissues. There seems to be some connection between this There is a marked disease and acute glaucoma. tendency to relapses. Treatment comprises opening of the vesicle, scarifications of the cornea, atropine, escrine, heat, paracentesis, or iridectomy if the intra-ocular pressure is increased, hypodermic injections of morphia for the spasm of the lids. Recovery generally takes place with no worse damage than opacity of the cornea,

Page 108. Keratoplasty is an operation designed to remedy loss of vision from opaque cornea. It consists in excising a small piece of the cornea and replacing it by transplanting a graft of transparent cornea from another eye. The graft is taken, together with some flaps of the adjoining conjunctiva, from a freshly-enucleated human eye. It is accurately fitted to its new position and retained there by stitching the conjunctival flaps into openings in the ocular conjunctiva made to receive them.

Page 115. Iritis Spongiosa is a rare form of iritis which has been observed to occur independently, or combined with the plastic variety. It is characterized by a peculiar fibrinous exudation, which usually begins near the pupillary space, and spreads thence until it fills the whole anterior chamber; sometimes this occurs very suddenly; the exudation often looks like the lens dislocated into the anterior chamber; absorption usually takes place slowly, beginning at the periphery. Iritis Spongiosa has the same causes as other kinds of iritis. The prognosis is good, and unless combined with the plastic form no adhesions are left. The treatment is the same as that of the plastic form.

Page 136. The use of magnets has been proposed [McKeown, Belfast, Ireland, 1874,] for re-

moving paces of steel or iron from the eye. By this means such foreign bodies have been extracted from the anterior parts of the eye, as well as from the lens and vitreous humor. A powerful magnet is used, and its end must taper to a small point, so that it can be introduced within the eve. It is very useful as a probe for exploring the wound for a piece of metal which cannot be seen. Or, it may be introduced through an incision specially made for it. By being moved about outside the eye it may cause a piece of metal within to move, and it has been thus used for diagnosis in doubtful cases. A deflection of the magnetic needle has also been observed to be caused by a piece of metal within the eye. [Pooley, New York.]

Page 142. Glaucoma.—It has been found recently that sulphate of eserine (see page 69) has valuable remedial powers in glaucomatous conditions. In certain cases of acute glaucoma it reduces the tension, improves the vision, and sometimes causes a temporary disappearance of all the bad symptoms. It may be tried preliminary to an operation, or where the latter is necessarily deferred, but cannot be regarded as a substitute for it. It is also used after operation, to aid in preventing a return of the symptoms. It is applied every few hours in solution of 2 to 4 grs. to the ounce.

Paracentesis of the cornea may also be done to reduce the tension where, for any reason, the iridectomy has to be delayed. Sperino [Italy, 19th

cent.,] recommends treatment of the disease by

repeated paracenteses.

An operation called sclerotomy has been proposed [De Wecker, 1867,] as a substitute for iridectomy, in cases where iridectomy is very difficult or dangerous, or where it cannot be performed at all. It is specially recommended in absolute glaucoma where an operation is done merely to relieve pain. The operation consists in making an incision in the sclera near the margin of the cornea. Enucleation is practised in cases of absolute glaucoma, attended by pain, which is not relieved by any other means.

Page 146. Optico-ciliary neurotomy [Von Graefe, Boucheron, Schoeler,] is an operation which has been developed since 1867 as a substitute for enucleation, in sympathetic ophthalmia, and in other cases where it is specially desired to save the eyeball. It consists in the division of the optic and ciliary nerves by a pair of curved scissors passed backward through an opening made in the conjunctiva. It is customary to divide one of the recti muscles to make room for the dissection (although this is not necessary), and its cut ends are reunited by sutures after the nerves have been divided.

Page 157. Electrolysis is very useful for destroying misplaced eyelashes where they are not too numerous. [Michel, St. Louis.] A fine needle is attached to the negative electrode of an ordinary galvanic battery, and a moist sponge to the positive one. The needle is passed into the follicle. either alongside of the hair, or after the latter has been pulled out, and the sponge is held upon the skin, as near as convenient. The current should be strong enough to decompose the tissue, which action is shown by frothing and swelling about the mouth of the follicle. If the operation has succeeded, the hair, in case it had been left in place, can be extracted with very little traction.

Page 158. *Ephidrosis* is an excessive secretion of the sweat-glands of the lids. It causes itching and biting sensations, and irritation and inflammation of the skin and of the conjunctiva. It is difficult of cure.

Chromhidrosis is a dark-blue or black discoloration of the skin of the lids, appearing suddenly, and capable of being washed off with glycerine or water. Seen chiefly in hysterical females, and supposed by some authors to be always due to simulation.

Xanthelasma, Xanthoma, or Vitiligoidea.—Appears as peculiar yellow patches, usually situated on the skin of the eyelids, and most often the upper lid, near the inner canthus. Sometimes the patch is raised a little, sometimes not. The disease is most common in females, and in those of middle age. Dissection shows that the connective-tissue cells of the parts are filled with fat. By some there is thought to be a connection between xanthoma and liver-trouble. Excision of the patches is proper treatment.

Pp. 163-165. The glass used behind the ophthalmoscope to get a clear view of the fundus in my-

opia or hypermetropia represents the degree of the refractive-defect practically, because it is held at about the same distance from the eye as would be the correcting spectacles. But to estimate the refraction accurately, we must consider the distance between the glass and the nodal point of the observed eye. In myopia the correcting-glass is stronger, and in hypermetropia weaker, than it would be if it could be placed at the nodal point. Hence, to obtain the exact degree of the myopia we add to the denominator of the fraction representing the focal length of the correcting-lens its distance from the nodal point. If the fundus is seen clearly through a - \ held 2 inches away, the real degree of myopia is \$10 = 16. In hypermetropia we subtract the distance. If the fundus is seen best through a + 1, held 2 inches away, the real degree of the hypermetropia is  $\frac{1}{8} = \frac{1}{6}$ .

Page 188. The dimensions of the ossicles are: Length of malleus from summit of head to short process, about 4½ millimetres; from short process, about 2 mm. Length of incus from summit of head to end of long process, about 5 mm. Length of stapes, about 3 mm.; greatest distance between crura, about 2 mm.; length of base, about 3 mm.; width, about 1 mm.

The long process, or processus Folianus [Cœlius Folius, Venice, 1645,] of the malleus, is also called the process of Rau, after Prof. Jacob Rau,

of the University of Leyden.

Page 208. Politzer's acoumeter has been la presented to the profession as a cheap, convent and uniform test for the hearing. It consists sentially of a steel cylinder 28 mm. long, joi to a small column of vulcanite, in which a l steel hammer is suspended. The lever of hammer can be depressed to a certain point, when liberated the hammer falls upon the cy der and sets it into vibration. The instrumer tuned to C2, and it gives a note of constant in sity and pitch, and louder than ordinary watc It is heard on the average about 15 metres. The is a pin fastened to the column, holding a si metal disc on its end. This disc is placed aga the skull if it is desired to use the instrument testing bone-conduction.

Page 208. It is always useful to compare aerial and bone-conduction for the tuning-fork. normal ear hears the sound of the fork be through the air than through the bones. the auditory nerve is predominantly affected, fork is almost always heard worse through bones than through the air: when the middle external ear is the chief seat of disease, the for heard best through the bones. A conven method of testing is to hold the vibrating fork a few seconds on the mastoid bone, and then posite the external meatus, and let the patient in which position it sounds loudest. A more act method is to hold it in one of these two r tions until its sound ceases to be heard, and t transfer it instantly to the other position; if sound is now perceived again, it proves that duction is better in the latter position than in the former.

The chief reason why a tuning-fork held on the teeth or the vertex is heard better in the deafer ear, when the deafeness is due to disease in the conducting portions, is, that the escape of the vibrations outward through the drum and auditory canal is obstructed,—more of them are thrown back upon the nerve, and the latter thus perceives the sound intensified. If, in such a case, the meatus is also plugged by the finger, the sound will be still further increased on that side. It is thought that when plugging the canal in this way does not intensify the sound, this fact is proof that the auditory nerve is involved: this view is not held by all surgeons.

The tuning-fork held on either parietal protuberance is heard better in the opposite ear in a normal case. This is still more noticeable if that ear is the seat of disease confined to the conducting

portions.

Testing the hearing in one-sided deafness requires great care, owing to the difficulty in excluding the good ear. The following methods are

useful:

Stop the better ear, and direct it toward the source of sound; then test the hearing, with the deaf ear alternately open and closed; if there is any difference found by the two tests, the balance is credited to the worse ear. [Dennert & Lucae, Berlin, 19th cent.]

Stop the affected ear, and pass a vibrating tuning-fork back and forth alongside of it. If the sound is not increased as the fork nears the meatus, it is concluded that the sound has been heard through the good ear. [Knapp, New York.] Stop the good ear, turn the affected ear toward the source of sound, and test the hearing; then test it again with the affected ear also stopped; if there is no difference, the conclusion is that the affected ear is totally deaf, and that the sound reached the auditory nerve of the good ear through the bones. But if stopping the affected ear makes the hearing worse, repeat the tests, nearer, until they are heard again. The difference between the hearing distance by the first test and the second will represent the loss caused by stopping the affected ear,—consequently, that ear's hearing distance by aerial conduction. [Burnett, Philadelphia.]

Page 212. Several useful modifications of Politzer's method of inflation have been proposed. Gruber [Vienna, 19th cent.] recommends that the patient, instead of swallowing water, say hic, hæc, or hoc; Dr. Tansley [New York], that he blow forcibly with puckered lips, and Dr. Holt [Portland, Me.], that he close the lips tightly and distend his mouth and cheeks with air at the moment when the air-bag is compressed.

Page 212. Emphysema from inflation.—When the mucous membrane is lacerated by a Eustachian catheter or bougie, the attempt to inflate the middle ear may cause emphysema of the tissues of the neck. Death has been caused in this way. The accident is very rare, however, and can only happen through great carelessness.

Emphysema sometimes occurs over the mastoid process, the air escaping by way of the middle ear and mastoid cells, through a congenital fissure in the bone.

Page 216. The auricle is subject, also, to erythema, erysipelas, herpes, syphilitic eruptions, frost-bite, etc. If any cold fluid is used in treatment, it should not be allowed to run into the auditory canal, lest it may excite inflammation of the deeper parts of the ear. In cases of frost-bite, it is necessary to guard against too sudden reaction: the auricle should be bathed with very cold water at first, and warmer applications made gradually.

Page 228. Sometimes exudations of serous fluid into the tympanum (hydro-tympanum) occur without any active inflammatory symptoms. The patient complains of deafness, a sense of stiffness, and, perhaps, of pressure. On inspection, the level of the fluid may be seen through the drum-head, and this may alter with a change in position of the patient's head; or bubbles of fluid may be seen behind the membrane; or there may be nothing evident save some slight alteration in the translucency of the part. Inflation, paracentesis, and attention to the throat and general condition are the chief means of treatment.

Page 235. Pulsation of the membrana tympani, without perforation, has been observed in rare instances. A few cases have been reported where the pulsation seemed to depend upon a vascular

growth in the tympanic cavity. Other symptoms present in these cases were redness and bulging of the drum-head, deafness, and an annoying pulsating tinnitus, synchronous with the heart-beat.

Page 236. Myringoplasty.—Skin-grafting has been successfully employed for forming a cicatricial drum-head in cases of chronic suppuration of the middle ear. The method pursued has been to transplant a piece of skin from the patient's forearm, either directly upon the exposed surface of the tympanic cavity, or upon the remains of the drum-head, the edges of which have been previously freshened. A simple protective dressing, as of borated cotton, is used. The operation is not likely to succeed unless all purulent discharge has ceased. Myringoplasty was performed upon two cases by Ely [New York] in June, 1878. The first cases published were those of Von Berthold, operated upon in August 1878, and reported in the Monatschrift für Ohrenheilkunde for November, 1878.

Cophosis [Gr. μωφος, deaf,] is a term some-

times used for deafness.

Hyperacusis [Gr. ὑπερ, beyond, and ακουη, hearing,] is that condition in which the ear is

hypersensitive to sound.

Diplacusis [Gr. διπλοος, double, and απουη, hearing,] paracusis duplicata, signifies double hearing. (See page 241.) There seems to be some confusion in the text-books in the use of this term. In certain cases of aural disease some sounds are heard naturally in one ear, but are heard one or more tones higher or lower in the

### APPENDIX.

other ear; that is, two distinct sounds are heard simultaneously, one true the other false. This is double hearing in the strictest sense of the term. This condition has been called diplacusis binauricularis. The condition which is much more common, and which is frequently described as double hearing, is that in which the last notes are heard repeated or echoed. Thus, the sounds are heard correctly until just at the close, when there is an echo-like repetition of higher pitch in the affected ear. Sometimes the same condition prevails in both ears, and all notes are heard falsely. These peculiar alterations in perception usually affect only the higher notes of the scale. Double hearing is most frequently complained of by people having a musical education, and it is more annoving to such persons than to others.

Page 220, Ear-cough, ear-sneezing, ear-vomiting. - Coughing, sneezing, and vomiting from irritations about the external auditory canal have been observed for centuries. Impacted wax or foreign bodies in the canal have been common causes. The phenomena are probably due to irritation of the branch [Arnold's nerve] of pneumogastric nerve, distributed to the walls of the external auditory canal. The text-books do not agree as to the existence of this branch in the canal, except as an anomaly. As good authorities as Sappey and Gruber describe it. Some authors ascribe ear-cough, etc., to irritation of the auriculo-temporal branch of the fifth nerve, and say that the communication with the pneumogastric occurs in the brain.

Page 220. Objective noises in the ear have been present in quite a number of reported cases. They are heard by the patient himself, and are also audible to others, sometimes at a distance of several feet. They are compared to fine mucous râles, or to the sound produced by rubbing the edges of the finger-nails together, or by rubbing the hair between the thumb and finger close to They are usually accompanied by spasmodic contractions of the muscles of the soft palate and throat, and sometimes by simultaneous movements of the drum-head. In some persons they can be produced voluntarily. Some consider them due to contractions of the tensor tympani muscle. Most authorities think that they have their origin at the pharyngeal mouth of the Eustachian tube, being caused by a separation of the moist lips of that orifice. In one case they were thought to be due to spasmodic contraction of the stapedius muscle. Sometimes the hearing is normal, sometimes it is temporarily reduced while the noises are occurring, sometimes it is already permanently impaired. Often there is catarrhal disease present. The cause of the spasmodic twitchings of the muscles is obscure.

Page 239. Several cases of primary disease of the mastoid process have been reported. Mastoid periositits, abscess, and caries have occurred without any apparent connection with the ear, no disease of the latter having been detected by the most careful examination.

Page 215. The Audiphone and Dentaphone .-

Since the first edition of this book appeared, two useful instruments have been invented for aiding the deaf to hear. The Audiphone was invented by Mr. R. S. Rhodes, of Chicago, Ill. It consists of a thin and elastic diaphragm of hard rubber fitted to a handle, so that the whole looks much like a fan. The upper edge of the diaphragm is bent toward the lower by silken cords attached to it, so that a convex surface is presented toward the source of sound, and a concave one toward the listener. The tension of the diaphragm can be regulated by the cords as best suits each case. In using the instrument, the upper edge is pressed firmly against the central incisors or the eye-teeth of the upper jaw.

The Dentaphone is a small circular box, fitted with a very delicate vibrating diaphragm, to which is attached a silken cord connected at its other end with a wooden tooth-piece. The receiver is held in the hand with the diaphragm directed toward the source of sound, while the piece of wood is held between the teeth, the intervening cord being

kept quite tense.

By both these instruments the sound-vibrations are conveyed to the auditory nerves by way of the bones of the skull. Hence they are only useful in those cases of deafness which are situated wholly or chiefly in the conducting portions of the ear. Their usefulness is in proportion to the integrity of the nervous apparatus. Like speakingtubes, they prove of decided benefit in a limited number of cases.

# 

# GLOSSARY.

The definitions of the words given below can be found by means of the page-references and index.

Amaurosis. Gr. αμαυροω, to render obscure, p.

141.

Amblyopia. Gr. aublus, dull, and ours, vision, p. 141.

Ametropia. Gr. α, privative ; μετρον, measure ; υψις, vision, p. 162.

Ampulla. Lat. ampulla, a flask, p. 193.

Anchyloblepharon. Gr. ay HUN wors, a stiffening, and Blegapov, eyelid, p. 97.

Annulus tympanicus. Lat. annulus, a ring, and tympanicus, tympanic, p. 179.

Anopsia. Gr. ava, without, and outs, vision, p. 141.

Antrum. Lat, antrum, a cave, p. 189.

Aphakia. Gr. a, privative, and paxos, lens, p. 168.

Arcus senilis. Lat. arcus, a bow, and senilis, senile, p. 39.

Asthenopia. Gr. a69evns, weak, and owis, vision, p. 162.

Astigmatism. Gr. a, privative, and Griyua, a point, p. 166.

Auricle. Lat. auricula, the external ear, p. 176.

Binocular. Lat. bis, twofold, and oculus, eye, p. 58.

Blennorrhæa. Gr.  $\beta\lambda\epsilon\nu\nu\alpha$ , mucus, and  $\rho\epsilon\omega$ , to flow, p. 92.

Blepharitis. Gr. βλεφαρον, the eyelid; and itis, denoting inflammation, p. 153.

Brachymetropia. Gr. βραχυς, short; μετρον measure; οψις, vision, p. 161.

Buphthalmos. Gr.  $\beta ovs$ , an ox, and  $o\varphi \Im \alpha \lambda \mu os$  eye, p. 101.

Canaliculus. Lat. canaliculus, a little channel, p. 38.

Canthus. Gr. καν 205, the angle of the eye, p. 33. Caruncle. Lat. caruncula, little piece of flesh, p. 37.

Cataract. Gr. κατα, and ρασσειν, to fall down.

Cerumen. Lat, cerumen, wax, p. 180. Chalazion. Gr.  $\chi \alpha \lambda \alpha \zeta \alpha$ , hail, p. 155.

Chemosis. Gr. χημη, a gaping; or χυμος, liquid (?), p. 91.

Chiasm. Gr. χιασμα, the letter χ, p. 5.

Choroid. Gr.  $\chi o \rho t o \nu$ , chorion, and  $\epsilon t \delta o \epsilon$ , like.

Chromhidrosis. Gr. χρωμα, color, iδρω5, sweat. Cilia. Lat. cilium, an cyelash, p. 35.

Concha. Gr. HOY XII, a concave shell, p. 177.

Cochlea. Gr. κοχλος, a snail with a spiral shell, p. 194.

Coloboma. Gr. κολοβωμα, a mutilation, p. 118. Conjunctiva. Lat. conjungere, to join together. Collyrium. Gr. κολλυριον, liquid eye-salce,

p. 70. Cophosis. Gr. 1ωφος, deaf, p. 256.

Corectopia. Gr. πωρος, acay, p. 250.
Corectopia. Gr. πορη, pupil, and εκτοπος, out of place, p. 118.

Coredialysis. Gr. πορη, pupil, and διαλυσις, a rupture, p. 113.

Corelysis. Gr. Hopn, pupil, Av615, loosing, p. 74.

Cornea. Lat. cornu, a horn, p. 10.

Cyclitis. Gr. κυκλος, a circle, and itis denoting inflammation, p. 123.

Dacryoadenitis. Gr. Δαμρυον, a tear; αδην, a gland; and itis denoting inflammation, p. 160.

Dacryocystitis. Gr. Δακρυον, a tear; κυστις, a bladder; and itis, denoting inflammation, p. 159.

Dacryops. Gr. Δακρυον, a tear, and wh, the

Deorsumvergens. Lat. deorsum, downward, and vergo, to turn, p. 147.

Diplacusis. Gr. Διπλοος, double, and ακουη, hearing, p. 256.

Diplopia. Gr. Διπλοος, double, oψις, vision, p. 54.

Distichiasis. Gr. Διστιχια, a double row, p. 155.

Ectopia. Gr. εκ, from, and τοπος, place, p.

Ectropion. Gr. εκ, from, and τροπη, a turning, p. 156.

Emmetropia. Gr. εν, within; μετρον, measure, and σοψ, eye, p. 161.

Entropion. Gr. εν, in, τροπη, turning, p. 156. Ephidrosis. Gr. επι, upon, iδροπ, sweat, p. 250.

Epicanthus. Gr. επι, upon, and καν Sos, angle of the eye, p. 158.

the eye, p. 84.

Fenestra. Lat. fenestr Fornix. Lat. fornix, as Fovea. Lat. fovea, a sr Fundus, Lat. fundus, Fusca. Lat. fuscus, dar

Gerontoxon. Gr. y Ept τοξον, a bow, p. 39. Glaucoma. Gr. γλαυκο Glioma. Gr. y hia, glue,

Habenula. Lat. habenul Hamulus. Lat. hamulus Helicotrema. Gr. έλισο a hole, p. 196. Helix. Gr. έλιξ, somethi

Hemeralopia

Hyperacusis. Gr. ὑπερ, beyond, and απουη, hearing, p. 256.

Hypermetropia. Gr. ὑπερ, beyond; μετρον, measure; and οψις, vision, p. 162.

Hypometropia. Gr. υπο, under; μετρον, measure; οψις, vision, p. 161.

Hypopion. Gr. ύπο, under, and πυος, pus, p. 138.

Incisuræ. Lat. incisura, an incision, p. 179.

Incus. Lat. incus, an anvil, p. 185.

Infundibulum. Lat. infundibulum, a funnel, p. 195.

Iridectomy. Gr. 1ρ15, the iris, and επτομη, a cutting out, p. 73.

Irideræmia. Gr. 1ρ15, the iris, and ερημος, wanting, p. 118.

Iridodesis. Gr. ιρις, the iris, and δεω, to bind, p. 73.

Iridodonesis. Gr. 1ρ15, the iris, and δονεω, to tremble, p. 117.

Iridotomy. Gr. 1ρ15, the iris, and τομη, a cut-

Iris. Gr. 1915, a rainbow, p. 16.

Keratitis. Gr. κερας, cornea, and itis, denoting inflammation, p. 99.

Keratocele. Gr. ηεράς, cornea, and ηηλη, a hernia, p. 103.

Keratonyxis. Gr. κερας, cornea, and νυσσω, to puncture, p. 74.

Lachrymation. Lat. lacryma, a tear, p. 89.
Lacus. Lat. lacus, a lake, p. 33.
Lagophthalmos. Gr. λαγως, a hare, and οφ.
βαλμος, eye, p. 157.

Leucoma. Gr. λευκος, white, p. 107. Macula lutea. Lat. macula, a spot, and luteus, yellow, p. 20.

Madarosis. Gr. μαδαρος, bald, p. 154. Malleus. Lat. malleus, a hammer, p. 185.

Manubrium. Lat. manubrium, a handle, p. 185.

Meatus. Lat. meatus, a passage, p. 179.

Metamorphopsia. Gr. μεταμορφοώ, to transform, and οψ15, vision, p. 170.

Micropsia. Gr. μιμρος, small, and oψις, vision, p. 170.

Modiolus. Lat. modiolus, the hub of a wheel, p. 194.

Mucocele. Gr. μυκος, mucus, κηλη, a tumor, p. 160.

Myodesopia. Gr. μυτα, fly; ειδος, like, ωψ, sight, p. 136.

Muscæ volitantes. Lat. musca, a fly, and volito, to fly about, p. 136.

Mydriasis. Gr. μυδος, moisture; because increase of fluids causes pupil to dilate (?), p. 116.

Myopia. Gr. μυω, to close, and ωψ, eye, p. 162. Myosis. Gr. μυω, to close, p. 117.

Myringitis. Lat. myringa, the drum-head; and itis, denoting inflammation, p. 225.

Navicularis. Lat. navicula, a small boat, p. 177. Nebula. Lat. nebula, a cloud, p. 107.

Neonatorum. Gr. veos, new, and Lat. natus born, p. 93.

Nictitation. Lat. nicto, to wink, p. 158.

Nyctalopia. Gr. νυξ, night, and οψις, p. 124.

Nystagmus. Gr. νυσταγμος, a noddin

Onyx. Gr. ονυξ, finger-nail, p. 102. Ophthalmoscope. Gr. οφβαλμος, eye, and σκοπεω, to look, p. 59.

Ora serrata. Lat. ora, a boundary, and serratus,

serrated, p. 21. Ossicula auditus. Lat. ossiculum, a small bone,

and auditus, hearing, p. 185. Otalgia. Gr. ovs, the ear, and alyos, pain, p.

242.

Othæmatoma. Gr. ους, ear, and αίμα, blood, p. 216.

Otolith. Gr. ovs, the ear, and AlSos, stone, p. 198.

Otoscope. Gr. ovs, ear, and σκοπεω, to look, p. 209.

Palpebral. Lat. palpebra, eyelid, p. 33. Pannus. Lat. pannus, a cloth, p. 105.

Panophthalmitis. Gr. πας, all; οφ θαλμος, eye, and itis, denoting inflammation, p. 119.

Papilla. Lat. papilla, a nipple, p. 33.

Patellaris. Lat. patella, a dish or plate, p. 24. Pectinatum. Lat. pectinatus, comb-like, p. 16.

Phakitis. Gr. φακος, lens, and itis, denoting inflammation, p. 130.

Phlyctenule. Gr. φλυκταινα, a pimple, p. 95. Phosphènes. Fr. phosphène, p. 170.

Photophobia. Gr. \pos, light, and \posos, dread,

P. 95. Photopsia. Gr. φως, light, and oψts, vision, p. 170.

Pinguecula. Lat. pinguis, fat, p. 97.

Pinna. Lat, pinna, a kind of sea-mussel, p. 176.
Polycoria. Gr. πολυς, many, and πορη, pupil, p. 118.

Potatorum. Lat. potator, a drinker, p. 131. Presbyopia. Gr. πρεσβυς, an old man, and oψις, vision, p. 167. Pterygium. Gr. πτερυγιον, a little wing, p. 95. Ptosis. Gr. πτωσις, a falling, p. 157. Punctum, Lat. punctum, a small hole, p. 33.

Reticularis. Lat. rete, a net, p. 203. Retina. Lat. rete, a net, p. 18.

Scala. Lat. scala, a stairway, p. 196.
Scintillans. Lat. scintilla, a spark, p. 137.
Sclerectasia. Gr. Gηληρος, and εμτασίες, a stretching out, p. 120.
Sclerotic. Gr. Gηληρος, hard, p. 8.
Scotomata. Gr. Gησος, darkness, p. 52.
Staphyloma. Gr. 6ταφυλη, a bunch of grapes,

p. 109. Stauungs papilla. Ger. stauen, to stow, to dam, p.

139. Stenopæic. Gr. στενος, narrow, and οπη, a hole p. 108.

Stillicidium. Lat. stillicidium, a dripping, p. 152. Strabismus. Gr. στραβίζω, to squint, p. 146.

Stroma. Gr. στρωμα, bedding, p. 13.

Sulcus. Lat. sulcus, a furrow, p. 9. Supercilium. Lat. supercilium, the eyebrow, p. 32.

Sursumvergens. Lat. sursum, upward, vergo, to turn, p. 147.

Symblepharon. Gr. 6υν, together, and βλεφαρον, evelid, p. 97.

Synchisis. Gr. 60v, together, and xv615, flowing, P. 137.

Synechia. Gr. συν, together, and εχω, to hold, γ 114. Tapetum. Lat. tapete, a carpet, p. 17.
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Tippitus Lat. tippitus a rippitus p. 200.

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Tragus. Gr. τραχωία, a roughness, p. 94.
Tragus. Gr. τραχος, a goat; because hairs like a goat's beard sometimes grow on this part (?),

Trichiasis. Gr. τριχιαω, to show hairs, p. 156. Tylosis. Gr. τυλος, a callus, p. 154. Tympanum. Lat. tympanum, a drum, p. 183.

Umbo. Lat. umbo, a boss, as that of a shield, p. 181.

Unguis. Lat. unguis, a finger-nail, p. 103. Utricle. Lat. utriculus, a small leathern bottle, p. 107.

Uvea. Lat. uva, a bunch of grapes, p. 12.

Vitreous. Lat. vitreum, glass, p. 24. Vorticose. Lat. vorticosus, full of eddies, p. 14.

Xerophthalmia. Gr. ξηρος, dry, and οφθαλμος, eye, p. 96. Xanthoma. Gr. ξανθος, yellow, p. 250.

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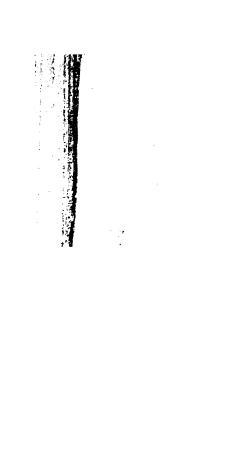
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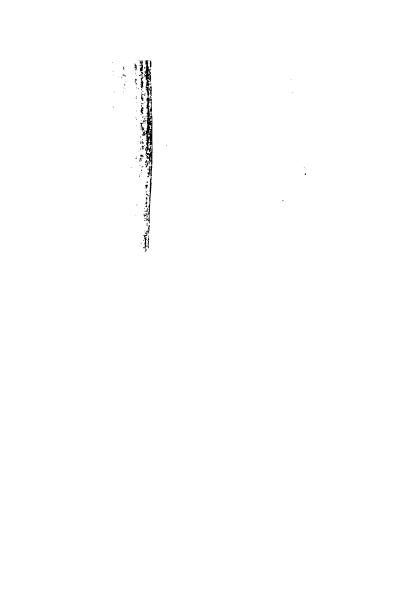
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